Conference Manual of AWPP2019

Contents

Welcome

Distinguished guests, respected colleagues, ladies, and gentlemen,

It is my pleasure and privilege to warmly welcome all of you to Beijing University of Chemical Technology (BUCT) to participate in the 18th Asian Workshop on Polymer Processing (AWPP2019). On behalf of BUCT, I would like to express my most sincere gratitude for your presence.

BUCT is a high-level university that aims to develop chemical talents at the cutting-edge of science and technology. As a national key university directly affiliated to the Ministry of Education of the People's Republic of China，and as one of the "211 Project" universities, the "985 Innovation Platforms for Advantageous Disciplines" and the "Double First-Class" universities, BUCT has taken responsibilities for creating knowledge, developing original technologies and training innovative talents.

By exerting our own distinctive strengths in research and education in chemical and related disciplines in the past half-century, BUCT has become a multidisciplinary research university with a solid foundation in science and engineering, as well as other distinctive disciplines such as management, economics, law, and so on. Since its establishment, BUCT has trained more than 160,000 talents. Our goal is to become one of the leading institutions in China as well as an influential university worldwide.

BUCT has also been attaching much importance to international exchanges, and has been cooperating with more than one hundred institutions, including those from Japan, the United Kingdom, the United States, Germany, Australia, Korea, and so on.

In the end, I sincerely hope the workshop will be successful and you will enjoy the following days of discussion, networking and touring in Beijing.

谭天伟

Honorary chairman
Prof. Tianwei Tan
President of Beijing University of Chemical Technology

About AWPP

It has been nearly 20 years since AWPP was firstly held in Bangkok, Thailand back in 2001. Since then, Asia has become the production base of plastic materials and processing technology for all over the world. As a result of this, it is important to set up an international conference in Asia which will provide a platform to exchange technology and information in the field of plastic materials and plastic products. Previous AWPPs have successfully enabled technology exchanges and have created the opportunity for researchers and engineers in Asia to gather at the same place to network. The conference will help researchers and engineers communicate with each other, share useful information, and create the chance for cooperative research for all attendees.

Previous AWPP annual conferences:

AWPP2001: Mar. 2001, Bangkok, Thailand

AWPP2002: Apr. 2002, Singapore

AWPP2004: Nov. 2004, Shanghai, China

AWPP2005: Oct. 2005, Taipei, Taiwan

AWPP2006: Dec. 2006, Bangkok, Thailand

AWPP2007: Oct. 2007, Daejeon, Korea

AWPP2008: Aug. 2008, Tokyo, Japan

AWPP2009: Dec. 2009, Penang, Malaysia

AWPP2010: Dec. 2010, Hanoi, Vietnam

AWPP2011: Sep. 2011, Qingdao, China

AWPP2012: Aug. 2012, Kyoto, Japan

AWPP2013: Dec. 2013, Goa, India

AWPP2014: Nov. 2014, Kenting, Taiwan

AWPP2015: Nov. 2015, Utown, Singapore

AWPP2016: Nov. 2016, Melbourne, Australia

AWPP2017: Oct. 2017, Hanoi, Vietnam

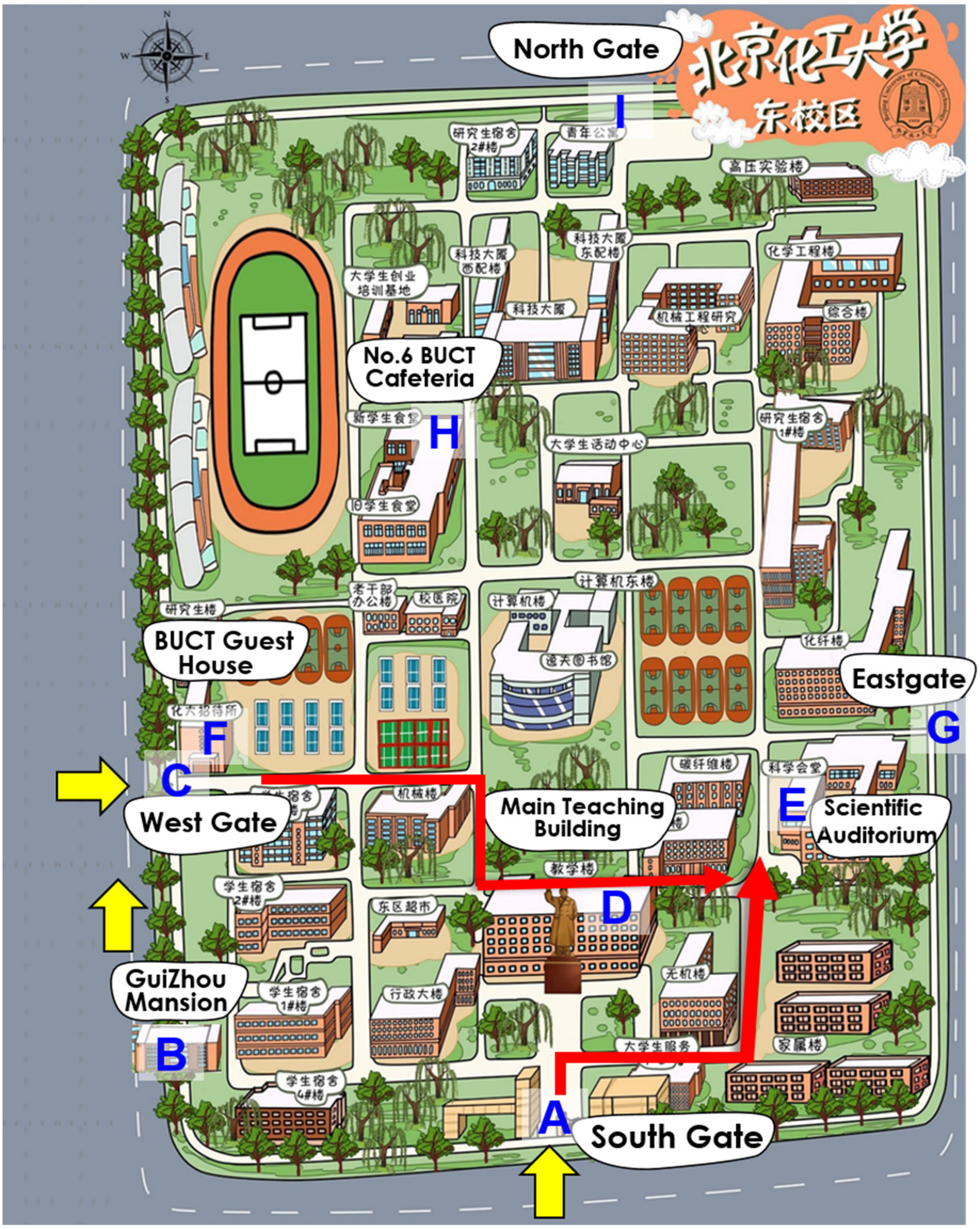
AWPP2018: Dec. 2018, Chiang Mai, Thailand

About BUCT

Beijing University of Chemical Technology (BUCT) is a high-level university that aims to develop chemical talent at the cutting-edge of science and technology. The university was established in 1958 and formerly known as the Beijing Institute of Chemical Technology. As a national key university directly affiliated to the Ministry of Education of the People's Republic of China， and as one of the "211 Project" universities, the "985 Innovation Platforms for Advantageous Disciplines" and the "Double First-Class" universities, BUCT has taken responsibilities for creating knowledge, developing original technologies and training innovative talents.

With half a century of history, BUCT has become a multi-disciplinary university with a solid foundation in science and engineering, as well as other distinctive disciplines such as management, economics, law, literature, education, philosophy, medical sciences. Since its establishment, BUCT has trained more than 160,000 talents for China.

Map of BUCT



A South gate **B** GuiZhou Mansion **C** West gate

D Main Teaching Building (***Oral Sessions & Poster Session***)

E Scientific Auditorium (***Opening Ceremony & Plenary Presentation***)

F BUCT Guest House G East gate **H** No. 6 BUCT Cafeteria ***(Lunch***) **I** North gate

Registration route

(1) From South gate: **A** South gate → **E** Scientific Auditorium

(2) From Guizhou Mansion or West gate：

C West gate → **D** Main Teaching Building → **E** Scientific Auditorium

Notes for Participants

Dining

1. Breakfast is provided by the hotel of each participant.
2. Lunch (12:15-14:00, Oct. 29th - 30th) at BUCT's No. 6 BUCT cafeteria.
3. Welcome Banquet (18:30-20:00, Oct. 29th): Participants should gather at the ***South Gate*** of BUCT and take shuttle buses to the ***DaZhaiMen Restaurant*** at 18:00 (**address**: *Building 3, Huixin Beili, Chaoyang District, Beijing*. **NOTE**: Don't forget to take your ticket of welcome banquet).

Sightseeing

Confirmation: Participants should confirm whether you will visit the *Great Wall* and the *Beijing Olympic Park* when you register for the conference on the official website.

Places: *Great Wall* & *Beijing Olympic Park* on Oct. 31st.

Departure: Participants should gather at the *West Gate* of BUCT at 8:30, Oct. 31st.

Return: We will get back to BUCT at about 16:00.

Contact

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Committee

Honorary Chairman

Prof. Tianwei Tan

President of Beijing University of Chemical Technology

Executive Committee of AWPP

Prof. Anup K. Ghosh	Indian Institute of Technology Delhi
Prof. Sati N. Bhattacharya	RMIT University
Dr. Rahul Gupta	RMIT University
Prof. Weimin Yang	Beijing University of Chemical Technology
Prof. Qiang Fu	Sichuan University
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Prof. Masaya Kotaki	Kaneka americas holding, Inc.
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Prof. Kyung-hwan Yoon	Dankook University
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Prof. Debes Bhattacharyya	University of Auckland
Prof. Chaobin He	National University of Singapore
Prof. Shih-Jung Liu	Chang Gung University
Prof. Shia-Chung Chen	Chung Yuan Christian University
Dr. Wannee Chinsirikul	National Metal and Materials Technology Center
Prof. Sommai	Rajamangala University of Technology Thanyaburi
Prof. Phan Trung Nghia	Hanoi University of Science and Technology
Prof. Takushi Saito	Tokyo Institute of Technology
Prof. Hiroto Murakami	Nagasaki University
Prof. Hiroyuki Nishimura	Kyoto Institute of Technology

Organizing Committee

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Prof. Weimin Yang

Beijing University of Chemical Technology

Co-chair

Prof. Pengcheng Xie

Beijing University of Chemical Technology

Secretaries

Ying An, Haoyi Li, Lisheng Cheng, Chao Zhang, Jing Tan, Lijian Song

Members

Shan Sun, Siqi Shi, Qi An, Xiaoqing Chen , Xiaodong Gao, Sida Wu, Xiahua Zuo, Gaojian Wu, Mingjun Chen, Haopeng Ma, Fangfang Yin, Zhenghe Zhang, Yuxuan Xu, Jiali Jiao, Chenghui Wang, Han Liu, Haoyang Li, Xibiao Li, Zibo Cao

Topics of AWPP2019

1. Alloys & Blends & Composites
2. Extrusion & Injection Moulding
3. Fiber & Film & Textiles
4. Polymer Modification & Novel Materials
5. Nano & Sol-gel Technology
6. Emerging Polymer Processing Technologies
7. Petrolium & Ceramic
8. Biopolymer & Bio-Food Technologies
9. Rheology & Rheometry
10. Structure & Properties & Simulation
11. Plastic & Green Products
12. Recycle & Environment & Energy

Language

English is the official language of the conference. No translation facility will be available.

Program at a Glance

Date	Time	Conference Program
Oct. 28 Monday	13:00-18:00	**Registration** *Location: Scientific Auditorium hall* Registration at other time: 07:30-12:30, Oct 29: *Scientific Auditorium hall* 12:30-18:00, Oct 29: *Main Teaching Building hall (1st floor)* 07:30-17:00, Oct 30: *Main Teaching Building hall (1st floor)*
Day 1 Oct.29 Tuesday	08:30-08:45	**Opening Ceremony** *Venue: Scientific Auditorium*
	08:45-10:15	**Plenary Presentation I** *Venue: Scientific Auditorium*
	10:15-10:45	Coffee Break *Location: Scientific Auditorium hall*
	10:45-12:15	**Plenary Presentation II** *Venue: Scientific Auditorium*
	12:15-14:00	Lunch *Location: No. 6 BUCT cafeteria (3rd floor)*
	14:00-15:25	***SESSION 1*** **Extrusion & Injection Moulding** *Room 116* ***SESSION 2*** **Fiber & Film & Textiles** *Room 120* ***SESSION 3*** **Structure & Properties & Simulation** *Room 115* *Venue: Main Teaching Building*
	15:25-15:45	Coffee Break *Location: Main Teaching Building, Room 123*
	15:45-17:10	***SESSION 1*** **Extrusion & Injection Moulding** *Room 116* ***SESSION 2*** **Fiber & Film & Textiles** *Room 120* ***SESSION 3*** **Structure & Properties & Simulation** *Room 115* *Venue: Main Teaching Building*
	18:30-20:30	Welcome Banquet *Location: DaZhaiMen Restaurant.*
Day 2 Oct. 30 Wednesday	08:30-09:55	***SESSION 4*** **Polymer Modification & Novel Materials** *Room 116* ***SESSION 5*** **Extrusion & Injection Moulding** *Room 120* ***SESSION 6*** **Rubber & Blends & Composites** *Room 115* *Venue: Main Teaching Building*
	09:55-10:15	Coffee Break *Location: Main Teaching Building, Room 123*
	10:15-11:35	***SESSION 4*** **Polymer Modification & Novel Materials** *Room 116* ***SESSION 5*** **Extrusion & Injection Moulding** *Room 120* ***SESSION 6*** **Rubber & Blends & Composites** *Room 115* *Venue: Main Teaching Building*
	11:35-12:15	**Poster Session** *Venue: Main Teaching Building (1st floor)*
	12:15-14:00	Lunch *Location: No. 6 BUCT cafeteria (3rd floor)*
	14:00-15:25	***SESSION 7*** **Emerging Polymer Processing Technologies** *Room 116* ***SESSION 8*** **Green &Bio materials, Recycle &Energy** *Room 120* *Venue: Main Teaching Building*
	15:30-16:00	**Closing Ceremony** *Venue: Main Teaching Building, Room 120*
Day 3 Oct. 31 Thursday	**Technical Tour** **Sightseeing:** *Great Wall and Beijing Olympic Park*	

Conference Agenda

Monday, 28 October, 2019		
13:00-18:00	Registration *Location: Scientific Auditorium hall*	
Tuesday, 29 October, 2019		
Opening Ceremony and Plenary Presentation ***Venue: Scientific Auditorium***		
7:30-12:30	Registration *Location: Scientific Auditorium hall*	
Opening Ceremony Chair: Prof. Weimin Yang		
08:30-8:45	Welcome Speech	Prof. Feng Wang *Vice President of Beijing University of Chemical Technology*
Plenary Presentation I Chair: Prof. Weimin Yang		
08:45-09:15	Design, Fabrication and Application of Advanced Elastomer Composites	Prof. Liqun Zhang *Beijing University of Chemical Technology*
09:15-09:45	Sustainable Plastics Engineering	Prof. Seeram Ramakrishna *National University of Singapore*
09:45-10:15	Toward high-performance stereotype-type polylactide/elastomer blends with good melt stability via one-pot reactive melt blending	Prof. Qiang Fu *Sichuan University*
10:15-10:45	Coffee Break *Location: Scientific Auditorium hall*	
Plenary Presentation II Chair: Prof. Seeram Ramakrishna		
10:45-11:15	Bio-inspired Carbon in Advanced Manufacturing	Prof. Mohini Mohan Sain *The University of Toronto*
11:15-11:45	Physical degradation theory of recycled plastics and the new research project of Japan based on this theory	Prof. Shigeru Yao *Fukuoka University*
11:45-12:15	Advanced polymer manufacturing and innovative applications	Prof. Weimin Yang *Beijing University of Chemical Technology*
12:15-14:00	Lunch *Location: No. 6 BUCT cafeteria (3rd floor)*	

Tuesday, 29 October, 2019		
SESSION 1 Extrusion & Injection Moulding *Venue: Main Teaching Building, Room 116*		
12:30-18:00	Registration *Location: Main Teaching Building hall (1st floor)*	
Chair: Porf. Guilong Wang ***Shandong University***		
14:00-14:25	**KEYNOTE**: Recent progress in experimental analysis of gas-venting process inside injection mold	Hidetoshi Yokoi, *Professor* *YOKOI Lab*
14:25-14:45	Examination of Weld-line with Compound Polypropylene on Injection Molding	Atsushi Mizutani, *Expert Leader* *Nihon University College of Industrial Technology*
14:45-15:05	Simulation Approaches for Insights into the Reactions of Polymeric Systems	Lisheng Cheng, *Associate Researcher* *Beijing University of Chemical Technology*
15:05-15:25	Measurement of shear stress distributions on cavity surface during melt filling process inside injection mold	Michihiro Tatsuno *The University of Tokyo*
15:25-15:55	Coffee Break *Location: Main Teaching Building, Room 123*	
Chair: Prof. Hidetoshi Yokoi ***YOKOI Lab***		
15:55-16:20	Fabrication of High Thermal Insulation and Compressive Strength PP Foams using Core-back Microcellular Injection Molding	Guilong Wang, *Professor* *Shandong University*
16:20-16:40	Quality monitoring, prediction and control of injection molding process	Ming-Shyan Huang, *Professor* *Kaohsiung University of Science and Technology*
16:40-17:00	Visualization analysis of wrinkle generation phenomenon of pp decorative sheets	Kaname KondoIdemitsu, *Project Leader* *Unitech Co., Ltd.*
17:00-17:20	Direct visualization of resin remaining inside hot-runner manifold during molding cycle	Shigeru Owada, *Project Researcher* *The University of Tokyo*
17:20-17:40	Experimental and numerical study of glass fiber attrition phenomena in twin screw extrusion-new simulation approach	Taki Kentaro, *Associate Professor* *Kanazawa University*
18:00	Gathering at the south gate of BUCT and Taking shuttle bus to Dazhaimen Restaurant	
18:30-20:00	Welcome Banquet *Location: Dazhaimen Restaurant* (*Address: Building 3, Huixin Beili, Chaoyang District, Beijing*)	

Tuesday, 29 October, 2019		
SESSION 2 Fiber & Film & Textiles *Venue: Main Teaching Building, Room 120*		
12:30-18:00	Registration *Location: Main Teaching Building hall (1st floor)*	
Chair: Prof. Xiaolong Jia ***Beijing University of Chemical Technology***		
14:00-14:25	**KEYNOTE**: Preparation of cellulose and its derivative fibers by plastification and reactive extrusion	Bowen Cheng, *Professor* *Tianjin Polytechnic University*
14:25-14:45	Research on Crystallization of Carbon Fiber Reinforced Polymer Composites	Shilun Ruan, *Professor* *Dalian University of Technology*
14:45-15:05	Experimental and numerical analysis of unstable behavior of melt blowing process	Takarada Wataru, *Assistant Professor* *Tokyo Institute of Technology*
15:05-15:25	Eco-friendly and effecient manufacturing of polymer nanofiber: melt differential electrospinning	Haoyi Li, *PhD* *Beijing University of Chemical Technology*
15:25-15:55	Coffee Break *Location: Main Teaching Building, Room 123*	
Chair: Prof. Shilun Ruan ***Dalian University of Technology***		
15:55-16:20	A New Environment-friendly Approach for High Efficient Reuse of Recycled Carbon Fiber Composites	Xiaolong Jia, *Professor* *Beijing University of Chemical Technology*
16:20-16:40	Stress-optical behavior in elongation and relaxation processes of PMMA film containing diphenyl sulfide	Shun Nakada *Tokyo Institute of Technology*
16:40-17:00	Study on Application of Polyethylene Terephthalate Film to Polarizer Protective Film	Murata Koichi, *General Manager* *TOYOBO CO.,LTD.*
17:00-17:20	Polymer melt differential centrifugal electrospinning	Yujian Liu *Beijing University of Chemical Technology*
17:20-17:40	High transparency PVC gel film preparation and application	Xudong Li *Beijing University of Chemical Technology*
18:00	Gathering at the south gate of BUCT and Taking shuttle bus to Dazhaimen Restaurant	
18:30-20:00	Welcome Banquet *Location: Dazhaimen Restaurant (Building 3, Huixin Beili, Chaoyang District, Beijing)*	

Tuesday, 29 October, 2019		
SESSION 3 Structure & Properties & Simulation ***Venue: Main Teaching Building, Room 115***		
12:30-18:00	Registration *Location: Main Teaching Building hall (1st floor)*	
Chair: Associate Prof. Takushi Saito ***Tokyo Institute of Technology***		
14:00-14:25	**KEYNOTE**: Preparation and structure repairing of highly oriented polymer thin films	Shouke Yan, *Professor* *Beijing University of Chemical Technology*
14:25-14:45	PVDF/HDPE blend-based nanocomposites with enhanced physical properties	Fang-Chyou Chiu, *Professor* *Chang Gung University*
14:45-15:05	Why are nuclear spin relaxation time measurements in rubber and polymer research and processing important?	Dr.Winfried Kuhn, *Managing Director* *IIC Dr. Kuhn GmbH&Co KG*
15:05-15:25	Micro and nano foaming for radiation heat effects	Fenghua Zhang, *PhD* *Beijing University of Chemical Technology*
15:25-15:55	Coffee Break *Location: Main Teaching Building, Room 123*	
Chair: Prof. Shouke Yan ***Beijing University of Chemical Technology***		
15:55-16:20	**KEYNOTE**: Simulation and experiment study of the structure-property relation of polymer nanocomposites	Jun Liu, *Professor* *Beijing University of Chemical Technology*
16:20-16:40	Measurement of Interfacial Thermal Resistance of Thermal Bonded Polymer Materials	Takushi Saito, *Associate Professor* *Tokyo Institute of Technology*
16:40-17:00	Attempt to Test the Oxygen Permeability of Plastic Pipe by Differential Pressure Method	Jia Ni *Menred Group Co.,Ltd.*
17:00-17:20	Research on parameter optimization and visualization of four-wing rotor	Tianjian Zhai *Qingdao University of Science and Technology*
17:20-17:40	Laser-induced graphitization of carbon fibers: an effective way for cost reduction and performance enhancement	Zhenghe Zhang *Beijing University of Chemical Technology*
18:00	Gathering at the south gate of BUCT and Taking shuttle bus to Dazhaimen Restaurant	
18:30-20:00	Welcome Banquet *Location: Dazhaimen Restaurant (Building 3, Huixin Beili, Chaoyang District, Beijing)*	

Wednesday, 30 October , 2019		
SESSION 4 Polymer Modification & Novel Materials *Venue: Main Teaching Building, Room 116*		
7:30-17:00	Registration *Location: Main Teaching Building hall (1st floor)*	
Chair: Prof. Ruixue Wang ***Beijing University of Chemical Technology***		
08:30-08:55	**KEYNOTE**: Easily peelable and strongly bondable behaviors of acrylic pressure sensitive adhesives bearing a long alkyl side-chain group	Hiroto Murakami, *Associate Professor* *Nagasaki University*
08:55-9:15	Improvement of the thermal conductivity of polymer composite based on the transformation mechanism of sand channel to stone channel	Jingyao Sun, *PhD* *Beijing University of Chemical Technology*
9:15-9:35	Development of imparting the adhesion of polypropylene surface using side-chain crystalline block copolymer	Sho Hirai *Fukuoka University*
9:35-9:55	Micro droplets jetting printing for the direct fabrication of multilayer wideband metamaterials absorbers	Baihong Chi, *PhD* *Beijing Institute of Satellite Information Engineering*
9:55-10:15	Coffee Break *Location: Main Teaching Building, Room 123*	
Chair: Prof. Hiroto Murakami ***Nagasaki University***		
10:15-10:35	Polymer surface modification by atmospheric-pressure plasmas	Ruixue Wang, *Processor* *Beijing University of Chemical Technology*
10:35-10:55	3D printable of biodegradable material of pla/pbat-nano talc composites	Wattanachai Prasong *Yamagata University*
10:55-11:15	Application of dielectric elastomer in artificial muscle	Yao Huang, *PhD* *Beijing University of Chemical Technology*
11:15-11:35	New technology application of injection molding	Alex Wu, *Technical Manager* *China-Top-Group*
11:35-12:15	**Poster Session** ***Venue: Main Teaching Building***	
12:15-14:00	Lunch Break *Location: No. 6 BUCT cafeteria (3rd floor)*	

Wednesday, 30 October, 2019		
SESSION 5 Extrusion & Injection Moulding ***Venue: Main Teaching Building, Room 120***		
7:30-17:00	Registration *Location: Main Teaching Building hall (1st floor)*	
Chair: Associate Prof. Yingguo Zhou, ***Jiangsu University of Science and Technology***		
08:30-08:55	**KEYNOTE**: High Efficiency and Energy-saving Manufacturing Technology of UHMWPE Products	Yanhong Feng, *Professor* *South China University of Technology*
08:55-9:15	Shear deformation and remolding condition dependence on mechanical properties of polyethylene: comparative study on different grade and structure	Patchiya Phanthong, *Postdoctoral Researcher* *Faculty of engineering, Fukuoka university*
9:15-9:35	Effect of talc size on surface roughness and glossiness of polypropylene injection molding application to automotive plastics	Shinichi Kuroda, *Assistant Manager* *Nissan Motor Co.,Ltd.*
9:35-9:55	Joining strength dependence on blasted metal surface textures in injection molded direct joining	Shuohan Wang *The University of Tokyo*
9:55-10:15	Coffee Break *Location: Main Teaching Building, Room 123*	
Chair: Prof. Yanhong Feng ***South China University of Technology***		
10:15-10:35	Compatibility, crystallization, foamability, and tensile properties of foaming injection molding parts of PP blends	Yingguo Zhou, *Associate Professor* *Jiangsu University of Science and Technology*
10:35-10:55	Tacking Injection Molding Related Issue with Next Generation of Simulation Technology : Viscoelasticity	Zhiwei Wang *CoreTech System Co., Ltd.*
10:55-11:15	Direct joining of non-crystalline polymer and surface fine-structured metal: effect of structure size	Akihito TAKEUCHI *The University of Tokyo*
11:15-11:35	Preparation and characterization of poly(butylene succinate)(pbs)/poly(lactic acid)(pla) foams using core-back foaming process	Dongho Kim *Kyoto University*
11:35-12:15	**Poster Session** ***Venue: Main Teaching Building***	
12:15-14:00	Lunch Break *Location: No. 6 BUCT cafeteria (3rd floor)*	

Wednesday , 30 October , 2019		
SESSION 6 Rubber & Blends & Composites ***Venue: Main Teaching Building, Room 115***		
7:30-17:00	Registration *Location: Main Teaching Building hall (1st floor)*	
Chair: Prof. Weiyu Cao ***Beijing University of Chemical Technology***		
08:30-08:55	**KEYNOTE**: Research on Rubber Processing Technology and Key Part	Chuansheng Wang, *Professor* *Qingdao University of Science and Technology*
08:55-9:15	Visualization of the structural evolution and interfacial properties in multi-component polymer blends	Dong Wang, *Professor* *Beijing University of Chemical Technology*
9:15-9:35	Study on wet mixing of natural latex and white carbon black system	Huiguang Bian, *Associate professor* *Qingdao University of Science and Technology*
9:35-9:55	Self-optimization of V/P switchover and Packing Parameters for Online Viscosity Compensation during Injection Molding	Yuxuan Xu *Beijing University of Chemical Technology*
9:55-10:15	Coffee Break *Location: Main Teaching Building, Room 123*	
Chair: Associate Prof. Huiguang Bian ***Qingdao University of Science and Technology***		
10:15-10:35	Heterogeneity of radial structure of carbon fibres and stabilized fibre	Weiyu Cao, *Professor* *Beijing University of Chemical Technology*
10:35-10:55	Properties and Applications of Chopped glass fiber Reinforced PEEK Material in the Rocket Structure of the Spacecraft	Haoliang Ding, *Senior Researcher* *Aerospace Materials and Technology Research Institute*
10:55-11:15	An enhanced interface constructed with graphene in SBR composites possessing high gas barrier properties	Shipeng Wen, *Associate Researcher* *Beijing University of Chemical Technology*
11:15-11:35	Structural Regulation of graphene for lubrication application	Jun zhao, *Associate Professor* *Beijing University of Chemical Technology*
11:35-12:15	**Poster Session** ***Venue: Main Teaching Building hall (1st floor)***	
12:15-14:00	Lunch Break *Location: No. 6 BUCT cafeteria (3rd floor)*	

Wednesday , 30 October , 2019		
SESSION 7 Emerging Polymer Processing Technologies ***Venue: Main Teaching Building, Room 116***		
Chair: Shigeji Konagaya Senior Researcher *Nagoya Industrial Science Research Institute*		
14:00-14:25	**KEYNOTE**: Manufacture of high-performance microcellular polymers by compression molding process foamed by supercritical carbon dioxide	Ling Zhao, *Professor* *East China University of Science and Technology*
14:25-14:45	The roles of unspinnable fluids in creating electrospun polymeric nanostructures	Dengguang Yu, *Professor* *University of Shanghai for Science & Technology*
14:45-15:05	No damage laser welding of PFA and PTFE sheets	Kimitoshi Sato, *Associate Professor* *Kokushikan University*
15:05-15:25	Investigation on abnormal mechanism of thermal protection coating	Lihong Su, *Associate Professor* *Northwesten Polytechnical University*
15:30-16:00	Closing Ceremony *Venue: Main Teaching Building, Room 120*	
SESSION 8 Green &Bio materials, Recycle &Energy ***Venue: Main Teaching Building, Room 120***		
Chair: Prof. Dengguang Yu *University of Shanghai for Science & Technology*		
14:00-14:25	Photocrosslinked poly(vinyl alcohol)(pva)/cellulose nanofiber(cenf) composites with high scratch resistance and transparency	Shigeji Konagaya, *Senior Researcher* *Nagoya Industrial Science Research Institute*
14:25-14:45	The change on the filler dispersion in SBR/silica under cyclic uniaxial elongation by in-situ ultra small angle X-ray scattering	Shotaro Nishitsuji, *Assistant Professor* *Yamagata University*
14:45-15:05	Application of Chinese ink in solar heat collection and photothermal evaporation	Xiahua Zuo *Beijing University of Chemical Technology*
15:05-15:25	Cellulose nanofiber reinforced thermoplastic composites-from processing to performances	Takeshi SEMBA *Kyoto municipal institute of industrial research and culture*
15:30-16:00	Closing Ceremony *Venue: Main Teaching Building, Room 120*	

Index of Keynote and Oral Presentations

Index	Title	Presenter
O-001	Recent progress in experimental analysis of gas-venting process inside injection mold	Hidetoshi Yokoi, *Professor* *YOKOI Lab*
O-002	Examination of Weld-line with Compound Polypropylene on Injection Molding	Atsushi Mizutani, *Expert leader* *Nihon University College of Industrial Technology*
O-003	Simulation Approaches for Insights into the Reactions of Polymeric Systems	Lisheng Cheng, *Associate researcher* *Beijing University of Chemical Technology*
O-004	Measurement of shear stress distributions on cavity surface during melt filling process inside injection mold	Michihiro Tatsuno *The University of Tokyo*
O-005	Fabrication of High Thermal Insulation and Compressive Strength PP Foams using Core-back Microcellular Injection Molding	Guilong Wang, *Professor* *Shandong University*
O-006	Quality monitoring, prediction and control of injection molding process	Ming-Shyan Huang, *Professor* *Kaohsiung University of Science and Technology*
O-007	Visualization analysis of wrinkle generation phenomenon of pp decorative sheets	Kaname KondoIdemitsu, *Project leader* *Unitech Co.,Ltd.*
O-008	Direct visualization of resin remaining inside hot-runner manifold during molding cycle	Shigeru Owada, *Project researcher* *The University of Tokyo*
O-009	Self-optimization of V/P switchover and Packing Parameters for Online Viscosity Compensation during Injection Molding	Yuxuan Xu *Beijing University of Chemical Technology*
O-010	Preparation of cellulose and its derivative fibers by plastification and reactive extrusion	Bowen Cheng, *Professor* *Tianjin Polytechnic University*
O-011	Research on Crystallization of Carbon Fiber Reinforced Polymer Composites	Shilun Ruan, *Professor* *Dalian University of Technology*
O-012	Experimental and numerical analysis of unstable behavior of melt blowing process	Takarada Wataru, *Assistant Professor* *Tokyo Institute of Technology*
O-013	Eco-friendly and effecient manufacturing of polymer nanofiber: melt differential electrospinning	Haoyi Li, *Beijing University of Chemical Technology*

Index	Title	Presenter
O-014	A New Environment-friendly Approach for High Efficient Reuse of Recycled Carbon Fiber Composites	Xiaolong Jia, *Professor* *Beijing University of Chemical Technology*
O-015	Stress-optical behavior in elongation and relaxation processes of PMMA film containing diphenyl sulfide	Shun Nakada *Tokyo Institute of Technology*
O-016	Study on Application of Polyethylene Terephthalate Film to Polarizer Protective Film	Murata Koichi, *General Manager* *TOYOBO CO.,LTD.*
O-017	Polymer melt differential centrifugal electrospinning	Yujian Liu *Beijing University of Chemical Technology*
O-018	High transparency PVC gel film preparation and application	Xudong Li *Beijing University of Chemical Technology*
O-019	Preparation and structure repairing of highly oriented polymer thin films	Shouke Yan, *Professor* *Beijing University of Chemical Technology*
O-020	PVDF/HDPE blend-based nanocomposites with enhanced physical properties	Fang-Chyou Chiu, *Professor* *Chang Gung University*
O-021	Measurement of Interfacial Thermal Resistance of Thermal Bonded Polymer Materials	Takushi Saito, *Associate Professor* *Tokyo Institute of Technology*
O-022	Why are nuclear spin relaxation time measurements in rubber and polymer research and processing important?	Winfried Kuhn, *Managing Director* *IIC Dr. Kuhn GmbH&Co KG*
O-023	Simulation and experiment study of the structure-property relation of polymer nanocomposites	Jun Liu, *Professor, Beijing University of Chemical Technology*
O-024	Attempt to Test the Oxygen Permeability of Plastic Pipe by Differential Pressure Method	Dongming Yu *Menred Group Co.,Ltd.*
O-025	Research on parameter optimization and visualization of four-wing rotor	Tianjian Zhai, *Qingdao University of Science and Technology*
O-026	Micro and nano foaming for radiation heat effects	Fenghua Zhang, *Beijing University of Chemical Technology*
O-027	Laser-induced graphitization of carbon fibers: an effective way for cost reduction and performance enhancement	Zhenghe Zhang *Beijing University of Chemical Technology*

Index	Title	Presenter
O-028	Easily peelable and strongly bondable behaviors of acrylic pressure sensitive adhesives bearing a long alkyl side-chain group	Hiroto Murakam, *Associate Professor* *Nagasaki University*
O-029	Improvement of the thermal conductivity of polymer composite based on the transformation mechanism of sand channel to stone channel	Jingyao Sun *Beijing University of Chemical Technology*
O-030	Development of imparting the adhesion of polypropylene surface using side-chain crystalline block copolymer	Sho Hirai *Fukuoka University*
O-031	Micro droplets jetting printing for the direct fabrication of multilayer wideband metamaterials absorbers	Baihong Chi *Beijing Institute of Satellite Information* *Engineering*
O-032	Polymer surface modification by atmospheric-pressure plasmas	Ruixue Wang, *Processor* *Beijing University of Chemical Technology*
O-033	3D printable of biodegradable material of pla/pbat-nano talc composites	Wattanachai Prasong *Yamagata University*
O-034	Application of dielectric elastomer in artificial muscle	Yao Huang, *Beijing University of Chemical Technology*
O-036	New technology application of injection molding	Alex Wu, *Technical Manager* *China-Top-Group*
O-037	High Efficiency and Energy-saving Manufacturing Technology of UHMWPE Products	Yanhong Feng, *Professor* *South China University of Technology*
O-038	Shear deformation and remolding condition dependence on mechanical properties of polyethylene: comparative study on different grade and structure	Patchiya Phanthong, *Postdoctoral researcher* *Faculty of engineering, Fukuoka university*
O-039	Effect of talc size on surface roughness and glossiness of polypropylene injection molding application to automotive plastics	Shinichi Kuroda, Assistant Manager *Nissan Motor Co.,Ltd.*
O-040	Joining strength dependence on blasted metal surface textures in injection molded direct joining	Shuohan Wang *The University of Tokyo*

Index	Title	Presenter
O-041	Compatibility, crystallization, foamability, and tensile properties of foaming injection molding parts of PP blends	Yingguo Zhou, *Associate Professor* *Jiangsu University of Science and Technology*
O-042	Tacking Injection Molding Related Issue with Next Generation of Simulation Technology : Viscoelasticity	Zhiwei Wang *CoreTech System Co., Ltd.*
O-043	Direct joining of non-crystalline polymer and surface fine-structured metal: effect of structure size	Akihito TAKEUCHI *The University of Tokyo*
O-044	Preparation and characterization of poly(butylene succinate)(pbs)/poly(lactic acid)(pla) foams using core-back foaming process	Dongho Kim *Kyoto University*
O-045	Research on Rubber Processing Technology and Key Part	Chuansheng Wang, *Professor* *Qingdao University of Science and Technology*
O-046	Visualization of the structural evolution and interfacial properties in multi-component polymer blends	Dong Wang, *Professor* *Beijing University of Chemical Technology*
O-047	Experimental and numerical study of glass fiber attrition phenomena in twin screw extrusion-new simulation approach	Taki Kentaro, *Associate professor* *Kanazawa University*
O-048	Study on wet mixing of natural latex and white carbon black system	Huiguang Bian, *Associate professor* *Qingdao University of Science and Technology*
O-049	Heterogeneity of radial structure of carbon fibre and stabilized fibre	Weiyu Cao, *Professor* *Beijing University of Chemical Technology*
O-050	Properties and Applications of Chopped glass fiber Reinforced PEEK Material in the Rocket Structure of the Spacecraft	Haoliang Ding, *Senior Researcher* *Aerospace Materials and Technology Research Institute*
O-051	An enhanced interface constructed with graphene in SBR composites possessing high gas barrier properties	Shipeng Wen, *Associate researcher* *Beijing University of Chemical Technology*
O-052	Structural Regulation of graphene for lubrication application	Jun zhao, *Associate professor* *Beijing University of Chemical Technology*

Index	Title	Presenter
O-053	Manufacture of high-performance microcellular polymers by compression molding process foamed by supercritical carbon dioxide	Ling Zhao, *Professor* *East China University of Science and Technology*
O-054	The roles of unspinnable fluids in creating electrospun polymeric nanostructures	Dengguang Yu, *Professor* *University of Shanghai for Science & Technology*
O-055	No damage laser welding of PFA and PTFE sheets	Kimitoshi Sato, *Associate Professor* *Kokushikan University*
O-056	Investigation on abnormal mechanism of thermal protection coating	Lihong Su, *Associate Professor* *Northwesten Polytechnical University*
O-057	Analgesics-eluting biodegradable nanofibers provide sustained pain relief in the nuss procedure	Shih-Jung Liu, *Professor* *Chang Gung University*
O-058	The change on the filler dispersion in SBR/silica under cyclic uniaxial elongation by in-situ ultra small angle X-ray scattering	Shotaro Nishitsuji, *Assistant Professor* *Yamagata University*
O-059	Photocrosslinked poly(vinyl alcohol)(pva)/cellulose nanofiber(cenf) composites with high scratch resistance and transparency	Shigeji Konagaya, *Senior Researcher* *Nagoya Industrial Science Research Institute*
O-060	Cellulose nanofiber reinforced thermoplastic composites-from processing to performances	Takeshi SEMBA *Kyoto municipal institute of industrial research and culture*

Index of Poster Presentations

Index	Title	Presenter
PS-01	Structures and properties of biaxially stretched thin piezoelectric films of poly(vinylidene fluoride)/polymethyl methacrylate blends	Ye Zhou Nanjing Tech University
PS-02	Electrospinning on a plucked string	Xiaoqing Chen Beijing University of Chemical Technology
PS-03	Effect of position and dimension of polypropylene injection molding products on mechanical properties and recycling characteristics	Yuki Kawakami,Saki Onishi Fukuoka University,SANKO GOSEI LTD.
PS-04	Aqueous Gold nanoparticles generated by AC and pulse power driven plasma jet	Yi Qi Beijing University of Chemical Technology
PS-05	Mechanical and morphological properties of cellulose nanofibers reinforced polymer composites	Tsubasa Ueda Yamagata university
PS-06	Comprehensive assessment of the environmental impact of FDM products produced under various performance requirements	Haopeng Ma Beijing University of Chemical Technology
PS-07	Molecular dynamics simulation of rupture mechanism in nanofiller filled polymer nanocomposites	Yangyang Gao Beijing University of Chemical Technology
PS-08	Electroless Plating On Polypropylene With The Surface Modification By Polydopamine	Wakatsuki Yuma Kyoto university
PS-09	A crawling soft robot driven by pneumatic foldable actuators based on Miura-ori	Meng Yu Beijing University of Chemical Technology
PS-10	Core-back foam injection molding of styrene-isobutylene-styrene compolymer (sibs) with n2 using polypropylene as a nucleating agent	Lin Weiyuan Kyoto University
PS-11	Laser-induced graphitization of carbon fibers: an efficient way for cost reduction and improving performance	Zhenghe Zhang Beijing University of Chemical Technology
PS-12	Toward High-temperature Dielectrics With Mechanical Robustness And Flexibility Based On Nanoscale Fibrillated Aramid-fibers	Yongsheng Zhao NorthwesternPolytechnical University

Index	Title	Presenter
PS-13	A quick response and tribologically durable graphene heater for rapid heat cycle molding	Huaguang Yang Beijing University of Chemical Technology
PS-14	A Comparative Study on the Optimized Weight of Injection-Molded Product using Taguchi Method and Artificial Neural Network	Dongcheol Yang Korea Institute of Industrial Technology
PS-15	Poly(norepinephrine) as a functional bio-interface to construct pH-responsive nanofiber mats and controlled release anticancer drug in vitro	Yanping Zhang Interdisciplinary Nanoscience Center
PS-16	A Comparative Study on Mold Deformation and Injection Pressure According to Melt Temperature During Injection Molding Using CAE Analysis	Junhan Lee Korea Institute of Industrial Technology
PS-17	Study on the Dynamic Shrinkage Evolution During UV-Curing Injection Molding	Le Song Beijing University of Chemical Technology
PS-18	Strain-Induced Crystallization and Molecular Orientation of Natural and Butyl Rubbers at Low-Temperatures as Revealed by Synchrotron Radiation WAXD	Pinzhang Chen University of Science and Technology of China
PS-19	ReaxFF molecular dynamics simulation of polyacrylonitrile heated up by microwaves	Chenhui Wang Beijing University of Chemical Technology
PS-20	Research and application of organic-inorganic nano-carbon composite materials	XiaoDong Gao Beijing University of Chemical Technology
PS-21	Tensile Behavior of Molecularly Twisted Polymeric Nanofiber: A Molecular Dynamics Simulation Study	Han Liu Beijing University of Chemical Technology
PS-22	Solar-driven interfacial evaporation based on double-layer Polylactic acid fibrous membranes loading Chinese ink nanoparticles	Xiahua Zuo Beijing University of Chemical Technology
PS-23	Polymer Melt Differential Electrospinning from a Linear Slot Spinneret	Mingjun Chen Beijing University of Chemical Technology

Index	**Title**	**Presenter**
PS-24	The Application of Co/Fe and N-doped Carbon Nanocatalyst for ORR/OER Electrode Materials	Haoyang Li Beijing University of Chemical Technology
PS-25	Effect of position and dimension of polypropylene injection molding products on mechanical properties and recycling characteristics	Saki Onishi Sanko Gosei Ltd.

O-002

Examination of Weld-line with Compound Polypropylene on Injection Molding

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1 Nissan Motor Co., Ltd. , Nihon University College of Industrial Technology

Introduction

This study is the examination that paid attention to weld-line after the painting in automotive plastic parts becoming the problem at real production. As for this related study, it has been studied until now, but there are few studies of the compound PP for Automotive. Therefore I investigated a reason to see it even if painted and the material influence of included rubber and talc and a molding condition.

Method

1) Surface condition and section observation

Firstly I observed it by the following experiment methods and an evaluation method about a factor to appear to be a line wound as weld-line in after the painting.

Material: Compound Polypropylene for automotive

Test piece: L320mm, B80mm, t2 ㎜ Two facing gates、Material Temp. 210□

Mold Temp. 35□ Surface and section observation： Scanning laser microscope, SEM

2) Observation of weld-line formation

The molding condition and material impact, talc and rubber was evaluated to investigate the minute upsurge in the Weld part. An experiment and the evaluation method are the same as the above.

Results & Discussion

1) Surface condition and section observation

Fig. 1 shows that the minute ditch of weld-line part is buried by a painting primer. But the upsurge occurs on the weld-line by Fig.2. It is founded that we recognize to be a linear wound because this upsurge occurred continually as showed Fig.3.

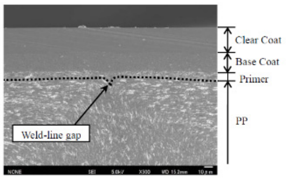

Fig 1. Section observation

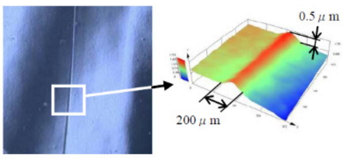

Fig 2. Surface condition

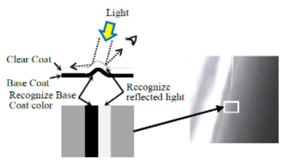

Fig 3 Recognized line

2) Observation of weld-line formation

As a result of comparing the orientation of material with the upsurge, talc and rubber of (a) orients big in the board thickness direction. But (b) having low embossment has little degree of orientation. Therefore it is understood that the orientation of the talc and rubber give minute upsurge relating the weld-line influence.

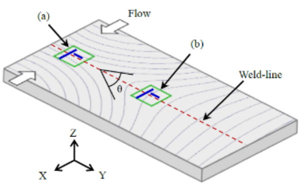

Fig 4. Observation Point

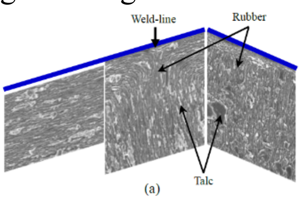

Fig 5. Section (a)

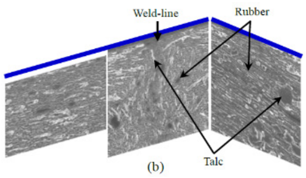

Fig 6 Section (b)

Keywords: Injection molding, polypropylene , weld-line, Automoti

O-004

Measurement of shear stress distributions on cavity surface during melt filling process inside injection mold

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Introduction: Measurement of shear stress distribution is important for examining phenomena occurring in the interface between the mold cavity surface and molten resin in injection molding. The authors developed a high precision measurement technique of shear stress distribution using a movable block and 3-component force transducer in the previous report. In this study, we analysed the influence of cavity surface properties on shear stress distribution.

Methods: Four kinds of surface properties of the movable block: mirror finish ("MR" hereafter)/ finely machined (FM)/ shallow grained (SG)/ rough grained (RG). Polypropylene was used in this experiment.

Results: Fig. 1 shows the influence of surface properties and injection rate (IR) on shear stress distribution. For the IR of all four properties, the shear stress rapidly increases immediately after the flow front (FF) makes contact with the cavity surface, becomes approximately constant from A, rises again in B afterwards, and shows a more or less constant value after C. The higher the IR, the higher is the shear stress, and the longer is the constant section of A to B. For surface properties, the shear stress is approximately equal for MR and FM, and it becomes higher in the order of SG, RG, meaning the rougher the surface, the higher is the shear stress.

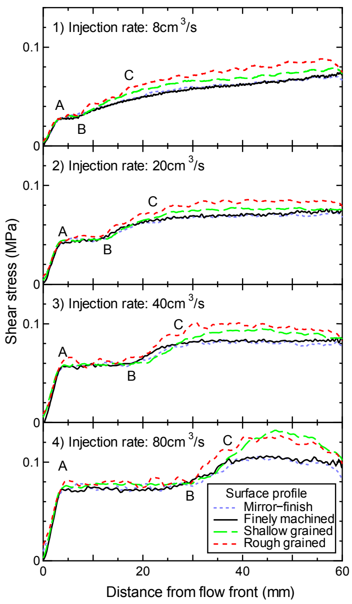

Fig. 1 Comparison of shear stress distribution curves under different cavity surface

Discussion: It is assumed that the shear stress distribution is for med from the following four areas depending on the distance from FF: (1) area which rises in the shape of steps (A in Fig. 1) , (2) area in which the shear stress remains constant and no solidified area has formed (A-B), (3) area whose shear stress increases with the growth of the solidified layer (B-C), (4) area whose shear stress remains a constant value due to the effects of shear heating and shear-thinning around the wall (after C). It is thought that area (2) became longer with increasing IR because the distance to be moved by FF, required for cooling to form the solidified layer, increases with IR. In addition, it is assumed that shear stress is higher for SG and RG than MR and FM in areas (3) and (4) because the growth of the solidified layer is accelerated by the increase in the area contacting the resins on grained surfaces.

Keywords: Injection molding, Shear stress distribution, Melt filling process, Grain-finished surface

O-006

Quality monitoring, prediction and control of injection molding process

Ming-Shyan Huang[1], Shih-Chih Nian[2], Jian-Yu Chen[3]

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Quality assurance and high production efficiency have always been important issues in the injection molding industry. With the development trend of Industry 4.0, more people are attracted to collect the physical information of polymer melt processed by the injection molding machine and the flowing behaviour in the mold, explain, extract features, and optimize the process quality, but with few successful cases are cited. This paper presents a series of studies on injection molding monitoring, prediction, and control based on in-mould and in-machine sensing information. The work consists of four parts: (1) Design quality index, which reveals the status of injection quality online. (2) Adjust the filling-to-packing switchover time corresponding to the environmental change. (3) Provide a systematic scientific molding test method to generate appropriate process parameter settings. (4) Optimize process parameter settings based on a fast and low-cost regression-model search method. Taking IC tray manufacturing as an example, in the shot-by-shot experiment, the warpage of the molded part was reduced from 0.62 mm to 0.20 mm, which confirmed the feasibility of our method.

Introduction: Quality control is a crucial issue in the injection molding process with target of obtaining a high yield rate and reducing production cost. Consequently, effective methods for monitoring the injection conditions (e.g., pressure, velocity, and temperature) in real-time and adjusting these conditions adaptively as required to ensure a consistent part quality are essential.

Methods: This paper presents a series of studies on injection molding monitoring, prediction, and control based on in-mould and in-machine sensing information. The work consists of four parts: (1) Design quality index, which reveals the status of injection quality online. (2) Adjust the filling-to-packing switchover time corresponding to the environmental change. (3) Provide a systematic scientific molding test method to generate appropriate process parameter settings. (4) Optimize process parameter settings based on a fast and low-cost regression-model search method.

Results: Taking IC tray manufacturing as an example, in the shot-by-shot experiment, the warpage of the molded part was reduced from 0.62 mm to 0.20 mm, which confirmed the feasibility of our method.

Discussion: In-mold and in-machine sensing information about polymer melt quality helps to understand its flow behaviour, and faciliates injection molding quality monitoring, feature extraction and control. In particularly, the tie-bar elongation signals detected from the strain gauge sensor is low cost, non-invasive to the mold structure, and potentially used for industrial needs.

Keywords: Cavity pressure, filling-to-packing switchover, injection molding, quality index, tie-bar elongation.

O-007

Visualization analysis of wrinkle generation phenomenon of PP decorative sheets

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Introduction: A transparent polypropylene (PP) sheet was evaluated for use for the decorative surfaces of automobiles, motorcycles and home electronics, because the sheet is light-weight and is an ideal material in terms of chemical resistance and recyclability. However, PP decoration sheet defects occur during in-mold injection molding, particularly wrinkling. In this study, we analysed the problem of decoration sheet wrinkle by visualization experiments of the molding process and measurement of the wrinkle depth.

Methods: We observed the wrinkle generation phenomenon of PP decorative sheets using a three-dimensional visualization mold and high-speed camera. Based on the obtained images, we measured the deformation amount of the sheet along its length in the flow direction for each screw injection speed (Refer to Fig.1).

Results: We found that the wrinkle generation phenomenon of PP decorative sheets during in-mold injection molding was caused by sheet deformation along the flow direction. The sheet deformation decreased logarithmically according to the increase in the screw injection speed (Refer to Fig.2). Furthermore, sheet deformation occurred in a very small area only for a short time immediately after the flow front passed (Refer to Fig.3).

Discussion: The final amount of deformation at the end of molding is the sum of each short time deformation, due to the fact that sheet deformation caused by in-mold molding only occurred for a short time after the flow front passed. These results suggest that sheet deformation occurring during in-mold molding should be considered focusing specifically on sheet deformation occurring for a short time after the flow front passed.

Keywords: in-mold molding, decorative sheet, wrinkle, visualization

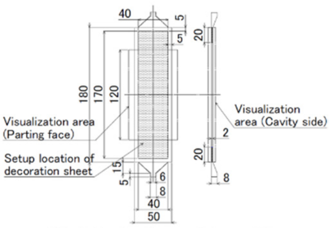

Fig.1 Cavity shape of the mold

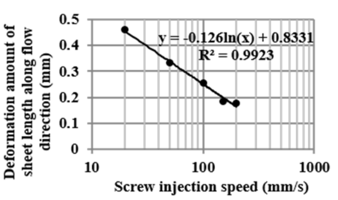

Fig.2 Relationship between screw injection speed and deformation amount of the sheet

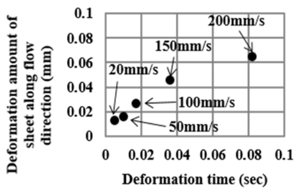

Fig.3 Relationship between the deformation amount of sheet and the deformation period at each observation area

O-008

Direct visualization of resin remaining inside hot-runner Fmanifold during molding cycle

Shigeru Owada, Hidetoshi Yokoi
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Introduction: Hot-runner system has excellent features, such as improved production efficiency and reduced material waste. However, it has been pointed out that if the melt stays in the flow channel for a long time or is overheated, the resin deteriorates and black specks appear in molded products. In this study, we focused on the mechanism of how black specks defect occurs and analyzed it by visualizing the behavior of resin remaining inside the hot-runner channel for a long time in the continuous repeated operation of the injection molding cycle.

Methods: The manifold of the hot-runner mold used in the study has a half-split structure and an inserted glass block to allow visualization inside. In this experiment, in order to promote resin deterioration, the manifold flow channel was filled with PS 679 (PS Japan) as an initial state. Then injection and stagnation of PC 3000R (MEP Co.) were repeated to observe the state of the melt in the flow channel. To evaluate resin deterioration, we determined the average luminance B-Lave of the Blue component in the RGB value from the video image of each shot.

Results and discussion: After 12 hours of stagnation under the initial condition of PS filling, the deep brown resin layer adhered and remained on the inner wall surface of the flow channel and the valve-pin surface. When the manifold temperature and injection cycle time were repeatedly increased/decreased, black specks appeared in a relatively short time (Fig.1). In particular, it was observed that the deep discolored resin layer on the valve-pin surface peeled and fell off in the fourth cycle (Fig.2). These results suggest that: Because the remaining resins are heated for a long time, they gradually deteriorate due to oxidation when air is drawn in by repeated heating/cooling of the manifold. The deteriorated resin layer partially breaks and drops due to shrinkage during mold cooling and peels off due to melt flow in the injection process (Fig.3), causing black specks in the molded product.

Keywords: Visualization, Hot-runner, Remaining resin

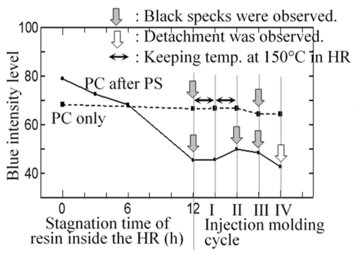

Fig.1 Change of average B-Lave

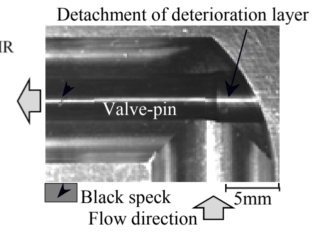

Fig.2 Observation of black specks

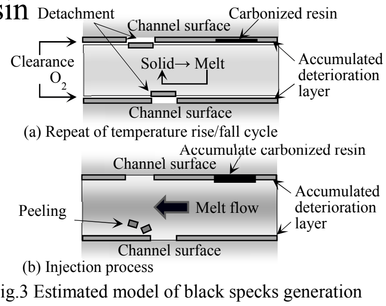

Fig.3 Estimated model of black specks generation

O-009

Self-optimization of V/P switchover and Packing Parameters for Online Viscosity Compensation during Injection Molding

Yuxuan Xu
Beijing University of Chemical Technology

Abstract

Injection molding is one of the most important forming method for thermoplastic polymers. In modern injection molding field, repeatability accuracy of machine parameters such as injection speed and V/P switchover has been raised to a high standard to produce high-quality part. However, because of non-Newton behavior of thermoplastic polymers, melt viscosity is still easily affected by the external environment, therefore, the weights of injection molding products are strongly fluctuant. To achieve a further improvement of products quality, an online optimization strategy is required which may sense environmental changes and conduct self-adjustment. This paper established a ratio between a filling equivalent value (FEV) and a viscosity equivalent value (VEV) based on cavity pressure which is directly related to melt properties to predict weight of melt that is filled into cavity. And on the basis of that, products quality is compensated by means of adjusting V/P switchover and packing parameters in each cycle on condition that viscosity fluctuates. After dynamic controlling experiments, the results indicate that V/P switchover and packing parameters are able to improve products quality and it is evident that weight fluctuations caused by viscosity changes are optimized a lot. It is proved that using a self-optimizing system is effective and necessary for injection molding processing.

Keywords: Injection molding; V/P switchover; Packing Parameters; Weight fluctuation; Self-optimization

O-012

Experimental and numerical analysis of unstable behavior of melt blowing process

Sho Hatano, Wataru Takarada, Takeshi Kikutani
Department of Materials Science and Engineering, Tokyo Institute of Technolog y, Tokyo, Japan 1528552

Introduction: Melt blowing is a one step process which produces nonwoven fabrics by extruding polymer melt through a die with orifices and extending the extruded polymer melt with a jet of hot air that rapidly attenuates the extrudate into small diameter fibers. In the melt blowing process, reduction of the polymer throughput rate and increase of the air flow rate are necessary to achieve fine fibers. When attempting to produce ultrafine fibers with diameters of the nanometer scale under such conditions, some reports indicate that the estimated fiber velocity which is calculated from spinning conditions using a continuous equation in spin-line at fiber formation exceeds the sound speed (supersonic). On the other hand, we had achieved medium diameter around 500 nm with much lower air and fiber velocities. To understand these results, we investigated the unstable behaviour of melt blowing process in experimentally and numerically.

Methods: Melt-blowing experiments was conducted using spinning instruments with 10 hole melt-blowing die. The melt blown fibers were collected using a wire-mesh set at the die to collector distance (DCD) of 10 cm. The images of collected fiber webs were obtained using a scanning electron microscope (SEM). Specific surface area (SSA) of collected webs were determined by BET method. For the in-situ observation of the thinning behavior of extrudates near the spinning nozzle, a high-speed camera was used at a frame rate of 4000 fps and resolution of 800 x 400 pixels.

Effect of surface tension and fluctuation of air velocity was investigated to understand unstable melt blowing behaviour using numerical analysis based on the Lagrangian representation of the equations.

Results and Discussion: Fig. 1 shows fiber diameter distribution at various throughput rate. Number average diameter greatly decreased at throughput rate less than 12.5 mg/min. On the contrary, weight average diameter increased in those conditions. High-speed video also showed spin-line became unstable in these conditions. Numerical analysis resulted that ultra-fine fibers were formed under unstable spinning conditions in exchange for small amount of thick fibers.

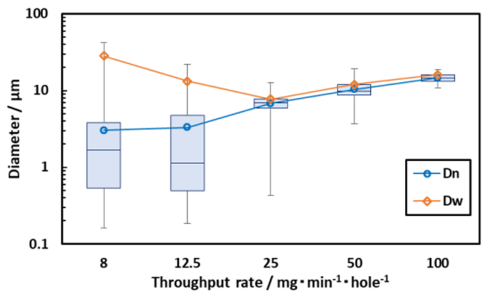

Fig.1 Fiber diameter distribution of melt blown webs at various throughput rate. Dn is number average diameter and Dw is weight average diameter.

Keywords: Melt blowing process, Spinning instability, Simulatio

Preparation of peo/egg white protein nanofibers by electrospinning for battery catalysis

Tingting Lv, Zhen An, Haoyi Li

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Abstract:

ABSTRACT: In order to expand the application field of electrospinning nanofibers and solve the problem of using a large number of toxic solvents in electrospinning process, egg white and polyethylene oxide (PEO) were mixed to prepare nanofibers by electrospinning. The morphology of egg albumin/PEO nanofibers was characterized by scanning electron microscopy, and the effects of solution concentration and spinning parameters on the morphology of the fibers were investigated. The elemental composition of the fibers was characterized by elemental analysis. The experimental results show that fibers with an average diameter of 389.45 nm have been successfully prepared by spinning with 50% solution mass fraction at 25 kV spinning voltage, 16 cm spinning distance and 0.2 mL/h extrusion speed. In addition, 11.02% of the nanofibers are nitrogen elements, and the protein in egg white has been successfully transformed into nano-particles. Fiber. This experiment does not use toxic solvents, which provides a reference for the application of protein fibers in biomedicine, battery catalysis and other fields.

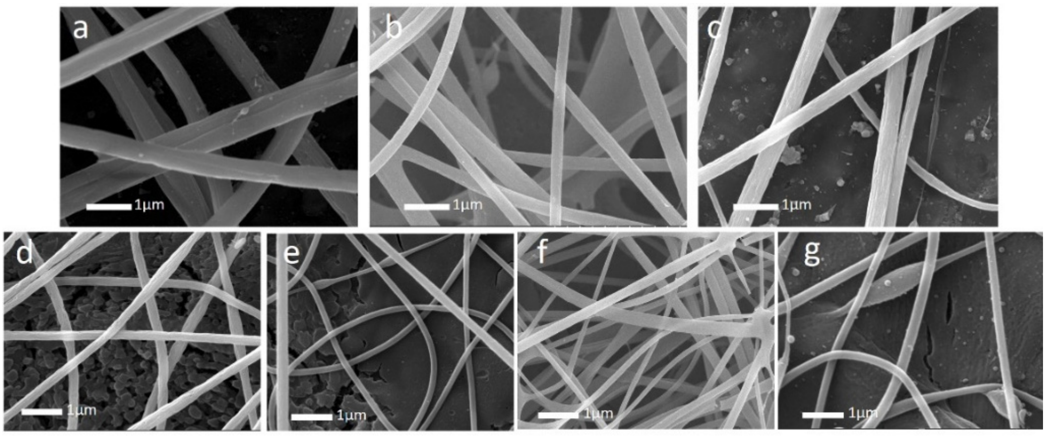


Figure 1. SEM picture of PEO/egg white protein nanofibers

O-015

Stress-optical behavior in elongation and relaxation processes of pmma film containing diphenyl sulfide

Shun Nakada[1], Wataru Takarada[1], Takeshi Kikutani[1]

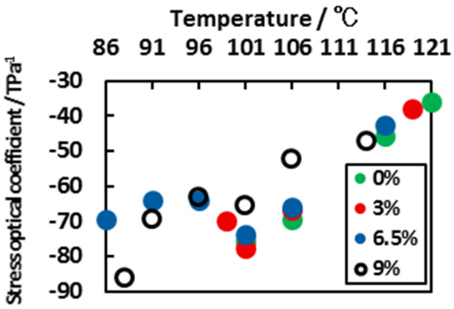
Tokyo Institute of Technology, Department of Materials Science and Engineering

Introduction: When polymer materials mixed with low molecular weight additives of anisotropic optical property are subjected to the deformation, birefringence development behaviour usually varies depending on the amount of the additives. This indicates that the low molecular weight component orients along with the orientation of the major component. However, details regarding the interaction between polymer chains and low molecular weight additives, such as the mechanism of cooperative orientation of the major and minor components and the relaxation time of each component, has not been fully understood yet. Therefore it is still difficult to predict the properties of final products fabricated with different processing conditions.

In this study, in-situ measurements of stress and birefringence developments during the uniaxial stretching of poly(methyl methacrylate) (PMMA) containing various weight fractions of diphenyl sulfide (DPS) were performed. From the stress-optical behavior of the film during the elongation and relaxation processes, the orientation and relaxation behaviors of the individual components were investigated.

Methods: PMMAs containing 0 (neat), 3.0, 6.5 and 9.0 wt% of DPS were used. Glass transition temperature (T_g) of the prepared materials decreased with the increase of DPS content as shown in Table 1. The decrement of T_g was approximately proportional to the content of DPS in this range. Films of these materials were prepared using a hot press under vacuum. Each film was uniaxially stretched up to the draw ratio of 1.5 at the stretching speed of 50 %/min, and then kept at the constant length for more than 15 min to observe the relaxation behavior. The stretching temperature was varied in the range of T_g+5 to T_g+ 36 °C. Simultaneous measurements of stress and birefringence were carried out during the stretching and relaxation processes.

Results and Discussion: Variation of stress-optical coefficient with temperature for the PMMA samples of different DPS content are shown in Fig. 1. It is known that the effect of temperature on the stress-optical coefficient is generally negligible for the small range of temperature change. However, the stress-optical coefficient of PMMA changed significantly within the temperature range of only 20–35 degree.



DPS content (wt%)

DPS content (wt%)	0	3.0	6.5	9.0
T_g (°C)	96	89	81	78

Table 1. T_g of PMMAs containing different weight fractions of DPS.

The stress-optical coefficient of PMMA was not affected much by the existence of DPS in the high temperature region. This result indicated that the influence of DPS on

the relaxation component at the later stage of relaxation process was small. On the other hand, in the lower temperature region, absolute value of the stress-optical coefficient tended to decrease when DPS was added. Data points are somewhat scattered, however, it appears that the deviation tends to start from higher temperatures and becomes more significant with the increase of DPS content. The deviation can be due to the remaining of the orientation of DPS, which has positive intrinsic birefringence, even though its orientation relaxation should proceeds more quickly in comparison with that for PMMA chain molecules.
Keywords: amorphous polymer, relaxation, stress-optical behavior, low molecular weight additive

O-016

Study on application of polyethylene terephthalate film to polarizer protective film

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Introduction: In recent years, polarizer films are required to improve the moisture durability. For this purpose, many studies have been conducted to apply a polyethylene terephthalate (PET) film as a polarizer protective film. In spite of the excellent moisture durability, PET film has a problem due to having birefringence. When it is used as a polarizer protective film, a coloring phenomenon called rainbow mura occurs. As a result of intensive studies, we found the problem can be solved by enhancing uniaxial orientation of PET film rather than reducing the birefringence of PET film.

Methods: PET films having different in-plane retardation "R0" and in-thickness retardation "Rth" were generated by various stretching condition. These optical properties describe the balance of three principal refractive indices (nx, ny, nz) of PET film. After that, these films were installed on the liquid crystal display (LCD) on the assumption that it was used as a polarizer protective film, and the visibility of the rainbow mura was observed. In addition, using the LCD simulator, the visibility of the rainbow mura was evaluated in the same configuration.

Results: FIG.1 shows the relationship between the optical properties of the PET film and the simulation result of rainbow mura obtained by the LCD simulator. It was confirmed that the contrast of rainbow mura decreases with increasing "R0", and also confirmed that the polar angle range in which rainbow mura appears becomes narrower with lowering "Rth". These result suggest that the rainbow mura can be reduced by enhancing uniaxial orientation of PET film while keeping its lower planner orientation. In this presentation, we explain the consideration for the mechanism reducing rainbow mura by controlling three principal refractive indices (nx, ny, nz) of PET film.

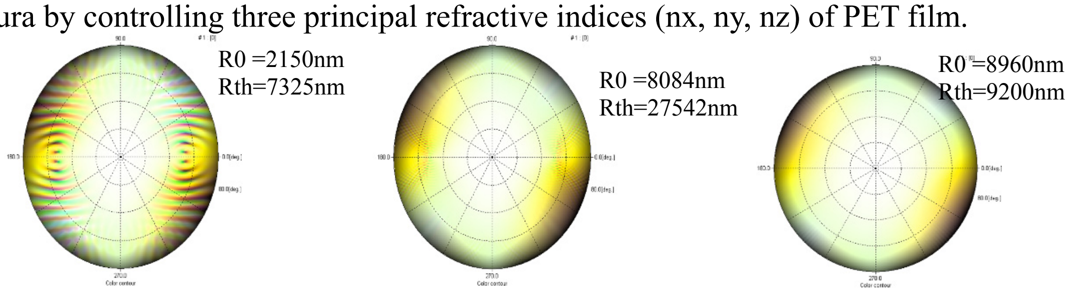

Fig 1. Simulation results of rainbow mura by LCD simulator

Discussion: From these results, it has been found that rainbow mura can be reduced by enhancing uniaxial orientation of PET film. This work makes it possible to apply PET film as a polarizer protective film, and it will greatly contribute to improve the durability of LCD.

Keywords: PET , Retardation , Birefringence , Polarizer protective film

O-020

Pvdf/hdpe blend-based nanocomposites with enhanced physical properties

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Purpose: This study focused on the investigation of CNT dispersibility, thermal properties (including crystallization/melting behavior and thermal stability), rheological, mechanical and electrical properties of prepared PVDF/HDPE/CNT samples.

Methods: Scanning electron microscopy, thermogravimetric analysis, differential scanning calorimetry, rheometry, mechanical properties analyses, and electrical resistivity measurement.

Results: In this study, carbon nanotube (CNT) was used to fabricate immiscible poly(vinylidene fluoride) (PVDF)/high density polyethylene (HDPE) blend-based nanocomposites via melt-mixing method. Scanning electron microscopy confirmed that the CNT was selectively located in the HDPE domains. Thermogravimetric analysis revealed that the addition of CNT improved the thermal stability of the blend. Differential scanning calorimetry results revealed that CNT enhanced the nucleation of PVDF and HDPE upon crystallization in the composites. The activation energy for non-isothermal crystallization of PVDF increased with increasing CNT loading in the composites. Heat distortion temperature (HDT) results showed that the CNT increased the HDT of the blend (up to 27 °C increase at 3-phr CNT loading compared to the blend). Increases in rheological properties of complex viscosity and storage modulus were detected with the addition of CNT into the PVDF/HDPE blend. Significant improvement in the rigidity of the blend was detected after adding the CNT.

Conclusions: PVDF/HDPE/CNT blend-based nanocomposites with PVDF as the major component were fabricated through a melt-mixing process. X-ray diffraction results confirmed that the crystal structure of PVDF and HDPE remained in the blend and composites. The electrical resistivity of the samples significantly decreased with the loading of CNT, up to 9 orders of drop at a 3-phr CNT loading. The electrical percolation was estimated at a CNT loading of 0.5-1 phr for the nanocomposites.

Keywords: Poly(vinylidene fluoride), High density polyethylene, Carbon nanotube, Nanocomposites, Physical properties.

O-021

Measurement of interfacial thermal resistance of thermal bonded polymer materials

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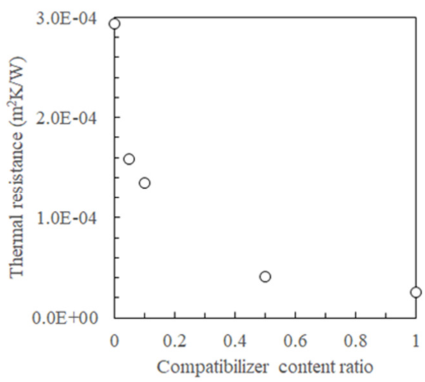
Introduction: The heat transfer mechanism in common polymer materials is considered to be mainly due to the thermal conduction by phonon vibration. Therefore, the scattering of phonon transfer occurring between molecules tends to lower the thermal conductivity in the bulk. For this reason, if the molecular affinity is low at the bonded interface of different polymer materials, it is presumed that heat transfer is inhibited because molecular penetration does not occur. On the other hand, it is expected that the interfacial thermal resistance will be reduced if the material affinity is improved by the existence of compatibilizer. In this study, the thermal diffusivity measurements of layered polymer materials containing different levels of compatibilizer were performed. From the obtained results, the influence of the material affinity by the compatibilizer on the interfacial thermal resistance of different polymer materials was quantitatively discussed.

Methods: As test materials, polystyrene (PS) and polycarbonate (PC), which have low mutual affinity, were used in this study. The affinity at the thermal bonded interface was controlled by changing the mass fraction of the compatibilizer mixed beforehand with the PC phase. In addition, the sample had a layered structure of 5 layers (PS/PC/PS/PC/PS). A periodic heating was applied in the orthogonal direction to the layered structure of this sample, and the apparent thermal diffusivity was calculated from the phase difference between the heating surface and the opposite surface. The interfacial thermal resistance of the sample interface satisfying the thermal diffusivity obtained experimentally was estimated by the one-dimensional unsteady heat transfer simulation.

Results: The obtained interfacial thermal resistance are summarized in the right graph, and the values were decreased as the mass fraction of the compatibilizer increased. In the initial state, the thermal resistance of about 3.0×10^{-4} m^2K/W existed at the PS/PC interface, and it was reduced to about 1/12 by the addition of the compatibilizer.



Keywords: Interfacial thermal resistance, Thermal diffusivity, Compatibilizer

O-022

Why are nuclear spin relaxation time measurements in rubber and polymer research and processing important?

Dr. Winfried Kuhn
IIC Dr. Kuhn GmbH&Co KG

Introduction:
Among other highly sophisticated methods, NMR (Nuclear Magnetic Resonance) is a outstanding because of it's sensitivity to nearest local interactions, and it's unsurpassed spectroscopic resolution. Consequently, NMR can be used in many different forms of appearance, e.g. as a tool for studying molecular mobility of hydrocarbon chains, network structure and the interaction of polymer matrix with filler particles.
Since NMR is a non-destructive testing method, the specimen under testing is not affected by the measurement procedure itself, and tested in it's native state. This opens up a completely new way of materials testing. Additionally, it allows the repeated measurements on the same sample. This is an indispensable requirement in order to apply statistical data analysis and hence, discriminate slightest differences in materials properties with highest precision.
Methods:
Nuclear Spin Relaxation Measurements have been carried out using IIC XLDS-15 HT Crosslink Density Analyzer. IIC's adaption of methods to measure T1, T2 and T1rho Nuclear Spin Relaxation Times using non-linear acquisition protocols result in data of highest precision and a repeatability of about 99%.
Technical rubber and polymer materials such as seals, tire samples, silicon and fluorinated rubbers have been investigated.
Results:
The results obtained show clearly variations of molecular mobility, expressed by the relaxation times, as a function of sample treatment and composition.
Filler/Polymer interactions could be analyzed, the effect of low molecular additives on rubber materials could be understood, changes of cross-link density as a consequence of different curing parameters, or aging could be identified.
Discussion:
The study of molecular mobility expressed by Nuclear Spin Relaxation Times such as T1, T2 and T1rho provide a deep insight into the molecular interactions of macromolecular materials. The results of these measurements can be used for both, the development of improved and new materials as well as for quality control of manufacturing processes and end products.
Keywords: NMR, Polymer/Filler interaction, Aging, Quality Control, Relaxation

O-023

Simulation and experiment study of the structure-property relation of polymer nanocomposites

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Beijing University of Chemical Technology

In this talk, we mainly introduce the progress of polymer nanocomposites studied through computer simulation and experiment, including the change of the dispersion state of the nanoparticles (NPs) as a function of the interfacial interaction, the physical and chemical interfacial interactions between polymer chains and NPs, the mechanical reinforcing effect and the tailoring effect of the visco-elasticity contributed by NPs, by considering the different cases such as spherical NPs, one-dimensional nanorod and two-dimensional nanoplatelet. With regards to the graphene sheets, we examine the intercalation kinetics of polymer chains into the confined space, by systematically investigating the effects of the temperature, chain length and chain flexibility. In the meanwhile, we also study the effects of the chain functionalization and the surface grafting of the graphene sheets on the dispersion of the graphene sheets. We find that compared to the anisotropic NPs, the end-functionalization effect has more pronounced effect to promote the dispersion of the spherical NPs. Compared to the case of the center-grafting, the edge-grafting of the graphene sheets is more effective to enhance the dispersion state and the mechanical properties. In addition, we examine the structure and dynamics of the interfacial polymer chains located between polymer and graphene, hoping to elucidate whether the glassy polymer layer exists in the interfacial region. Lastly, we introduce that utilizing the nano-springs and graphene with the reversible mechanical behavior can effectively reduce the hysteresis loss of the system. Similar to the uniform micro-phase separation of the thermoplastic block copolymer, we use the NPs to connect the dual end-groups of each polymer chain to construct the ideal network structure, which exhibits excellent static and dynamic mechanical properties. This particular kind of polymer nanocomposite provide some guidances for the development of the next generation of the energy-saving tires.
Keywords: rubber, visco-elasticity, reinforcement, simulation

Reference:

1. Jun Liu, Zijian Zheng, Fanzhu Li, Weiwei Lei, Yangyang Gao, Youping Wu, Liqun Zhang, Zhonglin Wang Nanoparticle chemically end-linking elastomer network with super-low hysteresis loss for fuel-saving automobile; Nano Energy, 2016, 28, 87-96. selected as the Cover Paper.
2. Jun Liu, Yong-Lai Lu, Ming Tian, Fen Li, Jianxiang Shen, yangyang Gao, Liqun

Zhang, The interesting Influence of Nanosprings on the Viscoelasticity of Elastomeric Polymer Materials: Simulation and Experiment; Advanced Functional Materials 2013, 23, 1156.
3. Jianxiang Shen, Xue Li, Xiaojun Shen and Jun Liu*; Insight into the Dispersion Mechanism of Polymer-Grafted Nanorods in Polymer Nanocomposites: A Molecular Dynamics Simulation Study; Macromolecules, 50, 687–699(2017).
4. Jun Liu, Dapeng Cao, Liqun Zhang, Wenchuan Wang; Time-temperature and time-concentration superposition of Nanofilled Elastomers: A Molecular Dynamics Study; Macromolecules, 2009, 42, 2831-2842.
5. Jun Liu, Yangyang Gao, Liqun Zhang, Dapeng Cao; Nanoparticle Dispersion and Aggregation in Polymer Nanocomposites: Insights from Molecular Dynamics Simulation; Langmuir, 2011, 27, 7926–7933.
6. Jun Liu, Jianxiang Shen, Yangyang Gao, Huanhuan Zhou, Youping Wu, Liqun Zhang; Detailed simulation of the role of functionalized polymer chains on the structural, dynamic and mechanical properties of polymer nanocomposites, Soft Matter, 2014, 10, 897

O-025

Research on Parameter Optimization and Visualization of Four-Wing Rotor

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Abstract
In this paper, the three-dimen-sional finite element method was used to simulate the mixing characteristics of the flow field in the mixing process of the internal mixer. The effects of rotor structure and process parameters on mixing performance were discussed. The rotor structure was optimized by MATLAB combined with particle swarm optimization(PSO) algorithm. The visualization of the real-time mixing process was realized with the help of high-speed camera using the self-developed visual mixer model. The rubber in the mixing process was simulated with hydroxypropyl methylcellulose (HPMC) as a medium, and the computer simulation results were compared. The simulation results were optimized by using the image acquired by the visualization platform. Based on the influence of geometric structure on the mixing effect, a new four-wing synchronous rotor design method was proposed. Finally, the experiment of rotor mixing effect was carried out on the bench of the internal mixer which can replace the rotor. The comparison with the experimental results verified the correctness of the numerical simulation results, and realized the experiment through the visualization experiment platform and computer simulation,which could accurate the prediction of results. Finally, the results were verified on the pilot machine to obtain the best design parameters.

Introduction: Elastomeric materials can achieve their complex structure and different functions by mixing polymers with specific physical and chemical properties and by particle-reinforced fillers necessary to crosslink the entire system to form a homogeneous network. Mixing is the first process in its processing, and the internal mixer is one of the necessary equipment for mixing.
The rotor is the core equipment of the internal mixer and is a prerequisite for obtaining high-quality rubber. Many scholars at home and abroad have conducted long-term theoretical and experimental research. On this basis, about 60 different types of rotors were born. Only by developing high-efficiency mixing equipment and high-performance mixing components can we meet the stringent requirements of the rubber industry in the new era and shorten the huge gap between China and foreign countries in the rubber field.

Methods: The main task of this simulation is to complete the optimization of the global distribution index of the mixer mixing process, which requires the use of MATLAB software and POLYFLOW software. Among them, the flow field simulation and mixed task analysis are mainly carried out in POLYFLOW software, which takes too long. Considering the factors such as the speed and accuracy of computer simulation, the flow field model and numerical simulation are assumed.

Then,the optimized rotor is 3D printed and placed on a visual experimental platform.The optimized rotor was subjected to a full formulation experiment to determine the properties of the rubber compound and the vulcanizate.

Results: Based on the theory of viscoelastic solids, the dynamic process of rubber mixing was simulated by EDEM. The contact model between the particles and the particles was studied. The soft ball model was used for the particles, and the contact model between the particles was Hertz-Mindlin with JKR Cohesion model. The JKR contact model was used to characterize the interparticle viscosity by setting the surface energy between the particles and the particles. The surface energy between the rubber and the rubber particles is determined to be 4 J/m2 by using the microscopic visual mixer experimental platform and the high speed camera. The surface energy between rubber and carbon black is 2 J/m2. In EDEM, two types of particles are used to represent rubber and carbon black, respectively, and the degree of mixing between the rubber and the compounding agent during rubber compounding is characterized by the mixing degree of the two kinds of granular materials. A physical model of rubber mixing was established, and the movement of the geometry was set.

Discussion:In this paper, the optimized solution process of the rotor was completed, and the optimized rotor configuration was obtained. The optimized geometry of the rotor was mainly reflected in the increase of the short rib length by 8 mm and the length of the long rib by 8 mm. The long-edge spiral angle was reduced by 1 degree, and the short-edge spiral angle was increased by 12 degrees. The optimized rotor configuration parameters were in accordance with the theoretical analysis of the influence of the ribs on the mixing effect.

Keywords: three-dimen-sional finite element method; rotor structure; mixing performance; visualization mixer; Four-Wing synchronous rotors

O-026

Study on the stability of bulk nanobubbles

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Abstract: As a new water treatment technology, microbubbles and nanobubbles have a good application prospect. The stability mechanism of bulk nanobubbles has not yet been worked out, which restricts the further development of this technology. According to the existing test results, it is found that there is a critical value in the size of nanobubbles. It is of great help to explain the stability of nanobubbles to find out the causes of the critical size. By testing the air nanobubble water and hydrogen nanobubble water, we found that the survival time of hydrogen nanobubble (about 7 days) was larger than that of air nanobubble (about 3 days). In addition, we put the produced nanobubble water on the vibrating table with different amplitude and frequency, and the results show that the effect of vibration on the stability of nanobubble can be ignored. In order to understand the stability mechanism of nanobubble, it is very important to study the interface of nanobubble. Next, we will mainly study the effect of molecular arrangement of nanobubble interface on the stability of nano-bubble.It is hoped that our work can lay a foundation for understanding the stability mechanism of nanobubbles!

Keywords: critical value,survival time,vibration,nanobubble interface

O-027

Laser-induced graphitization of carbon fibers: an efficient way for cost reduction and performance enhancement

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Graphite fibers are materials with a high specific modulus that have attracted much interest in the aerospace industry, but their high manufacturing cost and low yield are still problems that prevent their wide applications in practice. This paper presents a laser-induced process for graphitization of carbon fibers and explores the effect of laser radiation on the microstructure of carbon fibers. After laser radiation, a profound increase of graphitization degree happened and the interlayer spacing is dramaticlly decrease. Both the chemical and cryatal characterization reveal an enhanced ordered graphite-like structures were formed. The graphitized PAN-based fibers' modulus reached to 421 GPa a high modulus lever. Meanwhile, an electrical resistivity as low as 1.23 μΩ·m is recorded, matching the lowest conductivity ever publicly reported (Thornel K1100 MPCF). Study shows laser induced graphitization could be a potential way to reduce carbon fiber cost, multifunctional properties of carbon fiber and expand the market for energy devices electronic applications.

Keywords: Laser radiation; Carbon fiber; Graphitization

O-028

Easily peelable and storongly bondable behaviors of acrylic pressure sensitive adhesives bearing a long alkyl side-chain group

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1. Nagasaki University; 2. Nitta

Introduction: We have been studying easily peelable pressure sensitive adhesives (PSAs) by heat for the last decade. An acrylic PSA bearing a long alkyl group as a side-chain crystalline unit is thermosensitive, because the crystalline unit undergoes a reversible order-disorder with a change in temperature. Above the transition temperature, the side-chain groups form an amorphous state and becomes soft and flexible, leading to an appearance of tackiness. Below the transition temperature, the amorphous state changes into a crystalline aggregate and behaves as a hard plastic, leading to easy peeling. We call this behavior "Cool-off" (CO) function. By the way, hot-melt adhesive is a form of thermoplastic that melts when hot and solidifies by cooling, by which two materials are bonded. Therefore, based on a different point of view, the side-chain crystalline acrylic PSA structure can be used not only as the easily peelable PSA but also as the hot-melt adhesive. The structure can be also applied to alternative materials for wax and rosin which are used as a temporary adhesive for cutting and polishing in component processing processes. In this presentation, we describe design, synthesis and adhesion properties of a side-chain crystalline acrylic PSA that can be used as the wax alternative.

Methods: Behenyl acrylate (C22A, 45 wt%), butyl acrylate (C4A, 50 wt%), and acrylic acid (AA, 5 wt%) were polymerized in ethyl acetate with a radical initiator to obtain C4PSA. The C4PSA solution with an Al crosslinker was applied onto a PTF sheet using an applicator and then dried in an oven. The 180° peel test and dynamic viscoelastic measurement were carried out. As a reference, C1PSA (C22A/methyl acrylate/AA = 45/50/5 wt%) was also prepared, filmed with the Al crosslinker, and measured.

Results and Discussion: C1PSA (m.p. = 55°C) showed adhesion at 80°C and lost it at 23°C. This is the typical CO function. In contrast, the adhesion of C4PSA (m.p. = 47°C) at 23°C became larger than that at 50°C. This result suggests that C4PSA acts as the hot-melt adhesive. The enough lower storage modulus (10^4 Pa) at 50°C based on the lower glass transition temperature (T_g) of C4A unit enhances the wettability of C4PSA, which encourages "anchor" effect rather than "fastener" effect.

Conclusion: We demonstrated that the adjusting of T_g of side-chain crystalline acrylic PSA makes it possible to use as not only the easily peelable PSA but also the wax alternative adhesive.

Keywords: acrylic PSA, hot-melt adhesive, CO function, easily peelable

O-030

Development of imparting the adhesion of polypropylene surface using side-chain crystalline block copolymer

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Introduction: Polypropylene (PP) has been widely used in consumer products such as automotive parts and packaging materials; however, the use of PP was limited in other applications due to its low hydrophilicity and adhesive properties. There were numerous methods for imparting these properties of PP by polymer blending or surface modification. On the other hand, these methods had some drawbacks such as requirement of a special equipment and insufficient properties after modification. From this viewpoint, the development of adhesive properties on PP surface by using side-chain crystalline block copolymer (SCCBC) was investigated in this study.

Methods: SCCBC was synthesized by nitroxide-mediated living radical polymerization. The structure of polymerized SCCBC was shown in Figure 1. Surface modification on PP films were conducted by immersion into SCCBC solution for 10 min and air-dried for one day in order to remove the solvent. Then, two PP films modified by SCCBC were attached with a commercially available instant glue prior to evaluate the adhesion strength by tensile shear test.

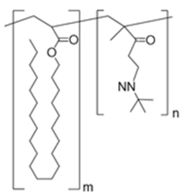

Figure 1 Chemical Structure of SCCBC.

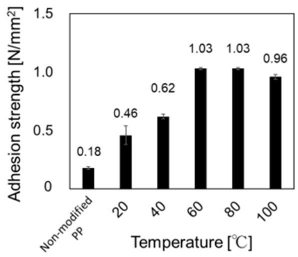

Figure 2 The result of tensile shear test.

Results and Discussion: Figure 2 shows the results of tensile shear test of non-modified PP and PP modified by SCCBC with different temperature of SCCBC solution. The adhesion strength of non-modified PP film was 0.18 N/mm^2 which indicated to the low adhesion strength. When PP films were modified by SCCBC solution at low temperature (20~40 °C), the adhesion strength was slightly increased. On the other hand, the adhesion strength was significantly increased up to 1.03 N/mm^2 after modified at high temperature (>60 °C). Therefore, we developed a facile modification technique to impart strong adhesive properties on PP surface by using SCCBC.

Keywords: Polypropylene, Side-Chain Crystalline Block Copolymer, Surface Modification, Adhesion, Chemical Treatment

Acknowledgment: This work was supported by the Japan Society for the Promotion of Science [JSPS KAKENHI Grant Number JP18K14010].

O-031

Micro Droplets Jetting printing for the direct fabrication of Multilayer Wideband Metamaterials Absorbers

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Abstract Multilayer structure is an important way to increase bandwidth of metamaterial absorbers (MA) as the development trend of multi-frequency or broadband. However, multilayer structure leads to complicated fabrication procedure as the absorber dimensional accuracy is hardly realizable. This paper proposes a Multilayer MAs on mixed micro-droplet jetting forming of silver paste/photosensitive resin, which can form the structure of absorber in an integrated way. Firstly, the scheme design of four-layer absorber and the simulation data of absorbing rate are carried out, and the effects of dielectric constant/dielectric loss of photosensitive resin and conductivity of silver paste on absorbing properties are analyzed. In addition, 20×20 units absorber samples were prepared and compared with the simulation results. The results indicate that the absorption of this absorber is greater than 90% in the frequency range of (10.4-19.6)GHz, which covers Ku band fully. Most importantly, the mixed Micro-droplet jetting forming provides a new way for the design and fabrication of multilayer wideband Mas, which has application value in the field of aerospace stealth.

Key Words: micro-droplet jetting forming; multilayer wideband; metamaterial absorbers; absorption

O-033

Polymer Surface Modification by Atmospheric-pressure Plasmas

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Introduction: An effective surface charge removal is critical to diverse applications of polymer and other soft organic materials in electrical devices and systems.

Methods: Here, we report on the application of atmospheric pressure plasmas to change the hydrophilic/hydrophobic properties, and to deposit SiO_x thin films to improve the surface charge dissipation on the polymer surface.

Results: The results showed that plasma treatment was a very effective method for polymer surface modification. The hydrophilic/hydrophobic surface can be obtained by controlling the working gas. Furthermore, The SiO_x nanofilms are formed at atmospheric pressure, with the replacement of organic groups with inorganic groups (Si-O-Si and Si-OH) within the thin surface layer. After the plasma deposition, the initial surface charge decreased by 12% and the surface charge dissipation was accelerated. The flashover voltage which characterizes the insulation property of the epoxy resin is increased by 42%. These improvements are attributed to the lower density of shallow charge traps introduced by SiO_x film deposition, which also corresponds to the surface conductivity increase.

Discussion: These results suggest that the SiO_x deposition by plasmas is promising to accelerate surface charge dissipation. This method is generic, applicable for other types of precursors and may open new avenues for the development of next-generation organic-inorganic insulation materials with customized charge dissipation properties.

Keywords: Atmospheric plasmas, polymer surface modification, surface charge dissipation, insulation

O-034

3D printable of biodegradable material of PLA/PBAT-nano talc composites

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Introduction: Biodegradable poly (lactic acid) (PLA) filaments have been widely used for fused deposition modeling (FDM) in 3D printing technology. However, there are limited applications due to its extremely low ductility. Therefore, this research aims to develop the ductile property of PLA filaments by blending with poly (butylene adipate-co-terephthalate) (PBAT). Moreover, nano talc was used as a filler in order to control dimensional stability of PLA/PBAT 3D printing products.

Methods: In this study, PLA/PBAT-nano talc composites were prepared by using twin screw extruder ((KZW15TW-30MG-NH (-700); Technovel Corp.). The pelletized PLA/PBAT-nano talc composites were extruded to be formed the 3D printable filaments using capillary rheometer (Capilograph 1D; Toyo Seiki Seisaku-sho Ltd.). The obtained 3D printable filaments were printed by FDM 3D printing machine (Da Vinci 1.0 PRO 3D Printer; XYZprinting, Inc.). Morphology, thermal property, mechanical property, and inter layer bonding of FDM 3D printed products were characterized.

Results and Discussion: Figure 1 (a) presents the tensile test result of PLA/PBAT-nano talc (70/30 wt%) 3D printing products (dumbbell shape), it was found that the maximum of elongation at break up to 410% can be obtained in the case of nano talc content 1 phr and it was gradually decreased when the talc content was more than 5 phr. The obtained elongation at break of 3D printing products of PLA/PBAT-nano talc was much higher than neat PLA due to the flexibility of the molecular chain of PBAT. Figure 1 (b) shows the appearance of PLA/PBAT-nano talc (70/30 wt%, talc 0-40 phr) 3D printing products. With increasing nano talc content in PLA/PBAT blends, degree of crystallization and crystallization temperatures were increased, resulting in the improvement of dimensional stability during solidification in the 3D printing process. This result suggests that the ductile 3D printable PLA/PBAT-nano talc filaments can be prepared and the dimensional stability of printing products was able to be controlled.

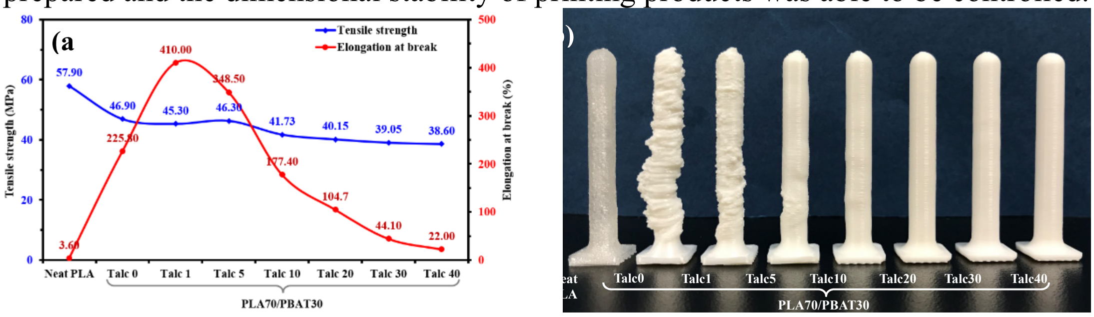

Figure 1 Stress-strain curves (a) and appearance of tower test (b) of PLA70/PBAT30-nano talc 3D printing products.

Keywords: Poly (lactic acid), Poly (butylene adipate-co-terephthalate), 3D Printable Materials

O-037

High efficiency and energy-saving manufacturing technology of uhmwpe products

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Introduction: Ultra-high molecular weight polyethylene (UHMWPE),as a comprehensive performance engineering plastic with excellent impact resistance, friction and wear resistance, chemical corrosion resistance, self-lubricating and low temperature resistance, has been used in petrochemical industry, metallurgical mineral processing, biomedical engineering, microelectronics, Marine engineering and military protection.However, UHMWPE melt presents a rubber-like high elastic state with extremely poor processing fluidity, so its high-efficiency moulding has always been an international problem, which also restricts the large-scale application of UHMWPE.

Methods: The eccentric rotor extruder (ERE) based on elongation rheology can effectively solve the extrusion and molding problems of UHMWPE. The rotation of the eccentric rotor and the rolling of the rotor in the inner cavity of a stator during constant reverse revolutions causes the volume of the space between the eccentric rotor and the stator to periodically change alternatively along the axial and the radial directions of the stator. Its transport capacity is only related to the rotor structure and is not affected by the molecular weight, viscosity and other material characteristics.

Results: The complete set of ERE pipe extrusion equipment can extrude UHMWPE pipe with molecular weight of 3.5 million, and the extrusion line speed is more than 30m/h. It was found that the yield strength, tensile strength, elongation at break and wear resistance of the products extruded by ERE increased greatly. Moreover, the ERE continuous preheating system and a pulse-vibration molding system were combined, which changes the heat conduction mode of ordinary moulding technology from outside to inside, greatly shortening the moulding cycle, and the products are more homogeneous with improved performance.

Discussion: In the solid transport section, rotor rotation causes UHMWPE powder to be subjected to periodic crushing and rolling. Therefore, by means of heat generated by particle friction movement and plastic deformation, it can realize low energy consumption, uniform and rapid heating of UHMWPE powder. In the melt plasticizing section, through the periodic change of the conveying volume, the elongational and compressive deformation of the material is further strengthened to make the material melt and plasticize uniformly. In the melt transport section, the dominant role of elongation flow and deformation effectively improves the entanglement, diffusion and orientation of UHMWPE molecular chain, improves the welding effect of particles and performance of UHMWPE products. Eccentric rotor extrusion and pulse vibration moulding technology can realize UHMWPE processing with low energy consumption, high efficiency and high quality, which will promote the wide application of UHMWPE in more fields.

Keywords: UHMWPE, eccentric rotor extruder, elongation rheology

O-038

Shear deformation and remolding condition dependence on mechanical properties of polyethylene: comparative study on different grade and structure

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Introduction: Shear deformation is one factor in material recycling which affects to decrease the mechanical properties of recycled plastics. In this study, virgin high-density and low-density polyethylene (HDPE and LDPE) are treated by shear deformation prior to remolding as thin film with various conditions. The original thin film without shear deformation (Org) and the shear-treated samples are evaluated the changes of mechanical properties. This study is expected to describe the different characteristics of physical degradation and regeneration of mechanical properties of PE based on the distinction of structures or similar structures with different properties.

Methods: Virgin PE pellets (HDPE grade FX201A, KEIYO; LDPE grade F522N and J2522, UBE-Maruzen) are prepared as tablet prior to perform shear deformation by using a cone-plate rheometer (Rheosol-G1000, UBM). Shear treatment condition is controlled at 180 ºC with 100 s-1 of shear rate for 5 or 10 min. Then, the obtained products are cut to small pieces prior to remold as thin film by hot compression at 180 ºC, 26 MPa, 2 min with slow-cooling (SC) or quench (Q).

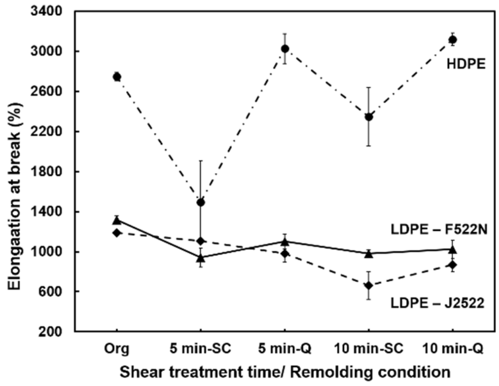

Figure 1. *Relationship between shear treatment time, remolding condition, and elongation at break of PE original thin film (Org) and shear-treated samples*

Results: From Figure 1, it can be found that shear treatment affects to decrease the elongation at break of PE, especially in remolding by SC. However, shear-treated samples with quench cooling reveal the regeneration of elongation at break

Discussion: Shear deformation has greatly affected on HDPE much more than LDPE. In other way, quench cooling leads to the higher regeneration of elongation at break in HDPE. These different results are caused from the distinctive structures between linear chain of HDPE and long chain branching of LDPE. Moreover, LDPE-F522N shows higher stability than LDPE-J2522 due to the lower of melt flow rate. From these results, it can be applied to improve the mechanical properties of recycled plastics from material recycling process.

O-039

Effect of Talc Size on Surface Roughness and Glossiness of Polypropylene Injection Molding Application to Automotive Plastics

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Introduction

Talc-containing polypropylene (PP) resin is extensively employed in automobiles. Considering microstructure transfer process in injection molding, the effect of the talc's dispersibility and particle size on this process and its impact on the gloss level of the product were investigated. The results show that a fine unevenness of about several μm was self-formed by the shrinkage of PP in non-transferred areas due to the blending of talc. Additionally, the amount of self-formed unevenness tended to increase as the average particle size of talc increased. Furthermore, it was observed that a fine tiger-stripe pattern was self-formed using special molds with modified microstructure due to PP shrinkage and density differences of talc. This self-formed fine unevenness changes the gloss level because of the effect of diffused light reflection. This study proposes a new perspective that this change can be controlled by the average particle size of talc and the structure of the mold.

Methods

Samples were produced using a base PP (Japan Polypropylene Corporation, NEWCON, NBX03HRS) in the state before talc and rubber components were added and talc (Shiraishi Calcium Kaisha, Ltd., MAT-725TP and Nippon Talc Co., Ltd., PAOG-10, P-6). The average particle size of talc has changed at three levels in PP containing 20 wt.% talc.

To examine the transferability of the vicinity of the gate and the flow end part that may occur in the molded product, a test specimen of 320 mm × 80 mm, t = 2.5 mm shown in Figure 1 was used and its transferability was evaluated in a position 300 mm away from the gate. In practical automotive bumper injection molding, the flow length from one gate is often in the order of 300 mm. In this study, we selected an area with decreased filling pressure for evaluation.

Results and Discussion

The impact of the change in talc content and average particle diameter of talc in the PP resin on transferability and gloss level was qualitatively and quantitatively presented.With the incorporation of talc, microirregularities of approximately several μm were self-formed by the shrinkage of PP in the untransferred region. Furthermore, the self-formed unevenness became more significant with an increase in the average particle diameter of talc. In particular, the addition of talc with a particle diameter of 20 μm or more causes a deformation of around several tens of μm to 20 μm. It was observed that a fine tiger-stripe pattern due to in-mold shrinkage and density differences in talc was formed in the untransferred area of the flat part along with the increase of Rsk deviation, which an index is showing the bias of mold irregularities. The gloss level increased with increasing Rsk deviation, but decreased with increasing average particle size of talc. A plausible reason for this is that the diffuse reflection of light is increased by the microirregularities formed in the untransferred area. In the past, the gloss level was controlled by changing the microstructure of the mold and accurately transferring the shape of the mold. This study has demonstrated that the gloss level of the product changes due to the microirregularities that talc produces by self-formation, and highlights the unrecognized possibility that this change can be controlled by the average particle diameter of talc and the structure of the mold.

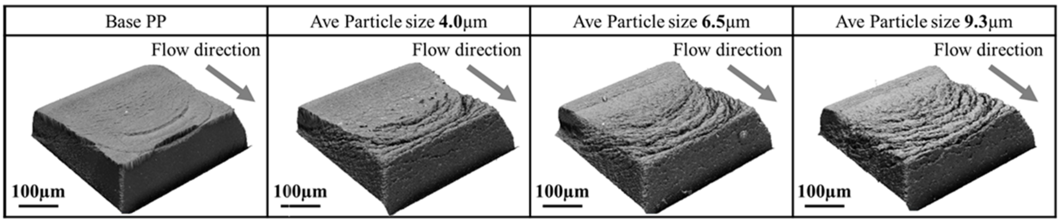

Figure 1: Effect of Rak and talc average particle size on transcribed shape's height and surface.

Keywords: automotive plastics, polypropylene, talc, micro-scale surface structure

Physical degradation theory of recycled plastics and the new research project of japan based on this theory

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Introduction: The ratio of mechanical recycling process in Japan has been maintained about 10 % for 20 years. Main reason is the poor mechanical properties of recycled plastics which are believed to have been due to the non-regenerable chemical degradation. From our previous studies, it can be found that the actual reason is physical degradation that comes from the changes of inner structure of plastic. Moreover, it can be also indicated that the physical degradation is caused from the history of heat and shear in molding process. From this reason, the mechanical properties can be regenerated by the suitable remolding condition.

(a)

(b)

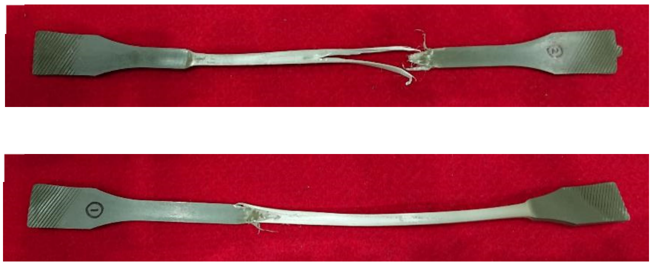

Figure 1 *Photo images of injection molding test specimen after tensile test. (a) general remolding condition, and (b) optimized remolding condition*

Results and Discussion: Figure 1 shows the injection molding test specimen of recycled polypropylene with different remolding condition. It can be found that the test specimen molded by a general remolding condition (Figure 1(a)) performs as a brittle material. In other way, with the suitable remolding condition (Figure 1(b)), the test specimen becomes an elongated sample. Based on these outstanding results which are successfully improved mechanical properties of recycled plastics, a new research project has been established in Japan from July 2019. The details information will be introduced in the conference presentation.

Keywords: Mechanical recycling, Physical degradation, Mechanical properties, Molding history

Acknowledgement: This research is supported by the Environment Research and Technology Development fund (3-1705) of Environmental Restoration and Conservation Agency, Japan.

O-040

Joining strength dependence on blasted metal surface textures in injection molded direct joining

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Introduction: Using lightweight materials is an obvious tendency towards the transport industry to reduce CO2 emissions and costs. Thus, joining metals and polymers can bring great benefits in especially aerospace and automobile industries. Injection molded direct joining (IMDJ) is one of the direct hybrid joining technologies. In the IMDJ process, micro size textures are manufactured on the metal surface at first, then molten polymer flowing over the roughen metal surface infiltrates surface structures by the injection molding process. In the texture manufacturing process, blasting pre-treatment on metal parts is a great method to lead into the transport industry for the lower cost and lower environment load. However, the relationship between metal surfaces textures and the joining strength is not so clear. Joining strength with the blasted pre-treatment sample is not high enough (usually over 20 MPa is required) to lead into the industry. Purpose of this study is to find influence texture parameter with joining shear strength and achieving higher joining strength by making a wide range of surface texture in blasting treatment.

Methods: For the blasting pre-treatment step, we used different size white alumina and different air pressure to create a wide range of textures on the surfaces of the aluminum alloy A5052 pieces. After the blasting process, we measured and analyzed the geometry of the blasted surface to obtain various surface parameters. Then we manufactured single lap joints by IMDJ in the constant molding condition, using 30% glass fiber reinforced polybutylene terephthalate (PBT). Five samples in each condition were used to perform the tensile shear test.

Results: By using different blasting conditions, we successfully obtained wide range surface textures whose roughness value *Ra* was from 2 μm to 11 μm. However, *Ra* did not have a strong correlation with shear strength. Among the various standard roughness parameters, arithmetic mean slope *Rda* had a strong correlation with shear strength. Moreover, the highest shear strength in this study reaches over 20 MPa with the most suitable *Rda*.

Discussion: We assume the main factor related to the higher strength is an anchor effect. The reason why *Rda* had a better correlation than *Ra* is that *Rda* represents the anchor effect quite well. *Ra* is a one-dimensional parameter representing height of a surface profile, whereas *Rda* is a two-dimensional parameter, which is necessary information for representation of the anchor effect. Future work will focus on how to enlarge and control *Rda* in blasting process and create new parameters which have a higher correlation.

Keywords: Metal-polymer hybrid joining, Direct joining, Blasting pre-treatment, arithmetic mean slope

O-043

Direct joining of non-crystalline polymer and surface fine-structured metal: effect of structure size

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Introduction: With the increasing use of multi-materials, direct joining of metal and polymer without screws and adhesives is highly needed for industrials. This research deals with injection molded direct joining (IMDJ) that is a method of direct joining between surface fine-structured metal and injection molded polymer; the anchoring at the fine-structured surfaces is considered as the main factor of joint. IMDJ using non-crystalline polymer has not been well investigated, although there are a lot of demands about that technology in industries. In this study, as a first step toward establishment of IMDJ using non-crystalline polymer, we investigated the size effect of the fine structure on the possibility of direct joining. We produced joint samples with two different sizes of metal structures under different injection speed and evaluated the joint strength.

Methods: We produced IMDJ samples with a single lap joint following ISO 19095, the materials of which were aluminium alloy A5052 and Polycarbonate (PC). Before joining, metal plates were treated with two ways to make fine structures on the surfaces. One group was laser processing to produce dimples arranged in a regular square grid. The other group was a combination of a removal of a native oxide layer and immersing in 90 °C hot water to form a nano needle shape structure on the metal surface. Then, we performed injection molding under different injection speed condition. To evaluate the joining, three samples were tested by a tensile shear test

.**Results:** The laser treated aluminium alloy plates and the injection molded PC were well joined. The higher injection speed resulted in the stronger metal-polymer joint; the strength achieved over 30 MPa which was the best in our previous studies. On the other hand, the hot water treated aluminium plates were not joined under any molding conditions in this work.

Discussion: Compared to the results of our previous studies using polybutylene terephthalate (PBT), the strength of joint between laser treated A5052 and PC was much higher. The reason can be the PC has lower stiffness than the PBT. During the tensile shear test, the lower stiffness provides the more relaxed stress at the interface, which can result in the stronger joint. Regarding the effect of injection speed, the reason is that the higher speed keeps the higher temperature and fluidity of melt polymer, which results in the higher infiltration into the surface dimples. This tendency was also seen in Al-PBT joint.

Keywords: direct joining, injection molding, non-crystalline polymer, nano structure

O-044

Preparation and characterization of poly(butylene succinate)(pbs)/ poly(lactic acid)(pla) foams using core-back foaming process

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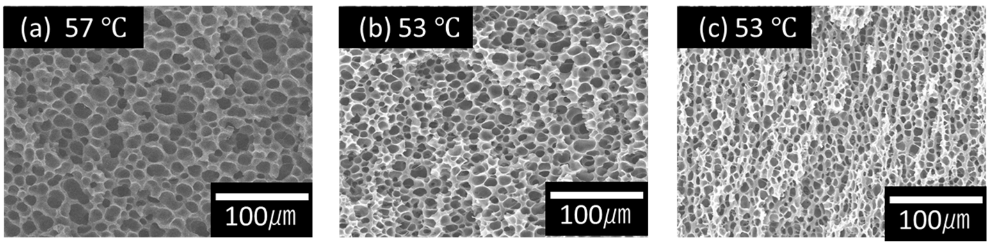
Introduction: Aliphatic polyesters poly(butylene succinate)(PBS) and poly(lactic acid)(PLA) are sensitive to hydrolytic degradation and biodegradable. PBS has good mechanical properties and processing capabilities. On the other hand, PLA is difficult to foam because of its slow crystallization rate and low melt tension. In this study, PBS and PLA were blended at various ratios to investigate the synergetic effect of the blend, especially on the operation window of foam injection molding.

Methods: PLA with 2% D-isomer content was used and blended into PBS. The PBS/PLA blend was foamed by a core-back foam injection molding process with N_2 as a physical blowing agent. The foam injection molding was conducted with different PLA contents and different foaming temperatures. The cell structure of the prepared foams was observed with SEM, and the rheology and thermal properties were measured by a rheometer and DSC, respectively.

Results: Figure 1 shows the cellular structure of threefold expansion foam from a view parallel to the core-back direction. As the foaming temperature was indicated on the upper left corner of each image, the comparison was made using the foams prepared at the almost same foaming temperature. With the increase of PLA content, the cell size was reduced, and the number density of cell was increased. In addition, PBS alone had



a wide foaming temperature window ranging from 37~119 ºC. The operating window was narrower with the increase of PLA content even though the cell size slightly became smaller.

Fig.1 SEM images of cell morphology of threefold expansion foams of PBS/PLA from a view parallel to the core-back direction. (a) pure PBS, (b) PBS/PLA 85/15, (c) PBS/PLA 70/30.

Discussion: PBS foam had a wider range of foaming temperature window. As the blend ratio of PLA increased, the temperature window became narrower and the cell diameter became smaller.

Keywords: Core-back Foam Injection Molding, Poly(butylene succinate), Poly(lactic

O-045

Research on Rubber Processing Technology and Key Part

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Abstract: The mixing process is the first process in rubber processing and one of the most critical processes. Mixing quality is the guarantee of the quality and life of rubber products. The mixing energy consumption reach to 55%.Therefore, on the premise of guaranteeing the quality of mixing gum, the focus of industry research is to shorten mixing time, improve production efficiency and reduce unit energy consumption.

Introduction:

1) Synchronous rotor mixing technology

Before the nineteenth century, Our country's large-sized internal mixer basically relied on imports. After the localization of internal mixers, it has become the main equipment for rubber mixing in china. The traditional shear-type internal mixer asynchronous rotors.Aiming at the problems existing in the traditional asynchronous internal mixer, a new method of synchronous rotor mixing is proposed, and a new system of intensified mixing technology is gradually constructed.

2) Tandem rubber continuous low temperature/ constant temperature mixing technology

This technology has developed a tandem rubber continuous mixer and a plurality of functional mixing elements such as a toothed disc, a shearing rib, an inter meshing rib, a large lead spiral and a variable gap spiral element. The compound rotor realizes the shearing, stretching, compression, stirring, mixing and axial reciprocating cutting of the rubber compound, and achieves the ideal mixing effect.

3)Mixing and Extrusion Integration Technology

Aiming at the problems of high energy consumption, low production efficiency and easy aging of rubber compound processing methods for rubber blending, the integrated molding processing method of blends was proposed to solve the mixing process and molding process of rubber and plastic blends. Particularly suitable for the production of waterproof membranes.

4) New rotor development system

The design software from rotor parametric design, simulation analysis to rotor optimization was developed. The rotor 3D printing, visual testing, small test, pilot-to-industrial experimental feedback platform was developed, and a new synchronous rotor design system was established

Keywords: Synchronous rotor;Continuous low temperature mixing;Mixing and extrusion

O-046

Visualization of the structural evolution and interfacial properties in multi-component polymer blends

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Introduction: Polymer alloys, blends, and composites have attracted much attentions in the past decades. SEM and TEM have been widely used for obtaining the structural information of these materials. However, the two methods never catch mechanical properties of such materials in general. The realization of much higher performance materials requires the new evaluation technique that enables us to investigate the structure and mechanical properties simultaneously. That is the purpose of our work using AFM nanomechanical mapping to investigate the structural evolution and interfacial properties of polymer composites.

Methods: In this work, we prepared polyolefin elastomer (POE)/polyamide (PA6) and HDPE/SEBS/PA6 composites. The sample was firstly microtomed using ultra-microtome. Then, the flat surface was analyzed by AFM force measurement (Multimode 8, Bruker, USA).

Results: As an example, Figure 1 shows the Young's modulus maps at the interfacial regions of the compatibilized and uncompatibilized POE/PA6 composites. As shown, the interface between the POE and PA6 in uncompatibilized blend is smooth and flat, whereas for the compatibilized blends the interface becomes quite rough after the same processing. Some parts of the POE domain appear to have pinched off at the interface and moved into the PA6.

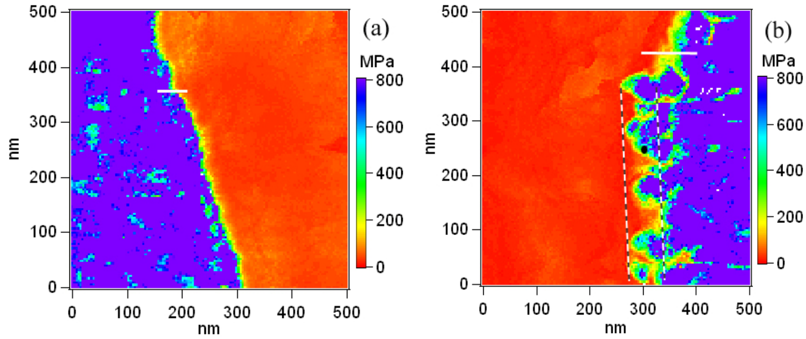

Figure 1. Interfacial roughening observed with nanomechanical map- ping: (a) POE/PA6 and (b) POE-g-MA/PA6 blends.

Discussion: AFM nanomechanical mapping has been obtained on a model reactive polymer blend of POE/PA6. This technique enables us not only to measure Young's modulus of the blend components but also to map the morphology of the POE/PA6 blend based on the Young's modulus of the constituting polymers. Furthermore, the most important result is that the interfacial morphology, width, and mechanical property of the blends can be easily evaluated based on the Young's modulus map with several hundreds of nanometers scan size. Comparing these results obtained from nanomechanical mapping with classical characterization methods used for compatibilization, such as TEM, this technique is promising in operation without any staining or coating, and it enables us to directly link the mechanical properties and morphology of the polymer blends.

Keywords: polymer composites, interface, atomic force microscopy; Rotor optimization

O-047

Experimental and numerical study of glass fiber attrition phenomena in twin screw extrusion – new simulation approach –

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Introduction: Self-wiping co-rotating twin screw extruder (TSE) is a versatile polymer processing machine where plasticization, mixing, blending, making composites, and devolatilization of volatile solvents and by-products. TSE is widely used in plastic industry and haven investigated by academic and industrial people. The glass fibre reinforced plastic (GFRP) is well-known as the plastics of which strength is higher than typical plastics. The pellets of GFRP are produced by the twin screw extruder. It is considered that glass fibres are broken by shear flow in resin on kneading disks of twin screw extruder. However, there is a little discussion about the role of flight screws and eventually the whole screw elements. In this study, we investigated the fibre attrition phenomena in whole screw elements in twin screw extruder with the aid of numerical simulation recently developed our group and experiments.

Methods: Three different homo polypropylenes of which melt flow rates are 0.5, 7.0, and 45 g/10-min (E-105GM, F-704NP, J108M, Prime Polymer, Japan) and chopped glass fibre (fibre length: 3 mm, fibre diameter: 13 μm, ECS 03 T-480, Nippon Electric Glass, Japan) were used, respectively. Self-wiping co-rotating parallel twin screw extruder (L/D = 64, φ26 mm, TEM-26SX, Toshiba Machine, Japan) was used. The screw configuration is shown in Fig.1. The feed rate of resin and glass fibre weight fraction were 10 kg/h and 10 wt.%, respectively. Screw rotation speed was changed from 80, 120, 160, and 200 rpm.

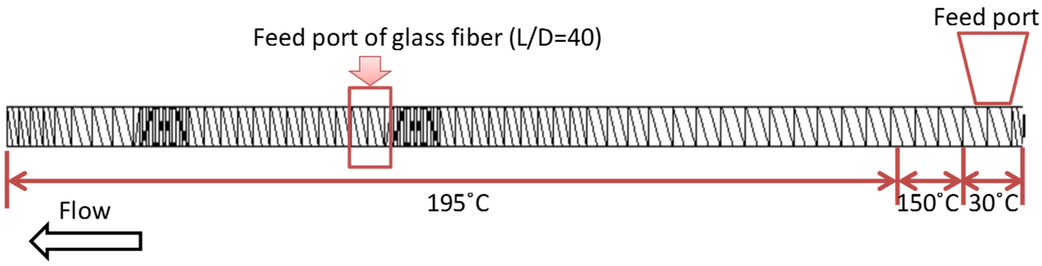
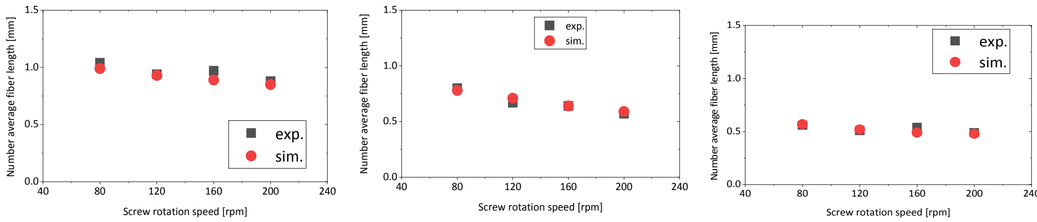


Fig. 1 Screw configuration of twin screw extruder.

Results and Discussion: Fig. 2 shows the number-average glass fibre length of extrudate of three different MFR polymers obtained from the numerical simulation and experiments. As shown in the figure, the fibre lengths are decreased with an increase of screw rotation speed. Employing Phelps and Tucker's fibre attrition model and the parameters determined at the screw speed of 200 rpm of F-704NP were used to simulate the fibre length for different resins and screw speed using the numerical calculation scheme of the Hele-Shaw flow model and finite element method developed in our group. As shown in the figures, the numerical simulation agreed well with experimental results.



(a) E 105GM (b) F-704NP (c) J108M

Fig. 2 Number-average fibre length of three different homo polypropylene.

Keywords: Twin screw extruder, glass fibre, numerical simulation, fibre attrition

0-049

Heterogeneity of radial structure of carbon fibre and stabilized fibre

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Introduction: Carbon fibre is a frontier material due to its superior properties. However, there is still a huge gap between realistic and theoretical mechanical properties. Heterogenous radial structure, which might inherent from stabilized PAN fibre, was regarded as the key reason that influence resultant mechanical properties of carbon fibre,

Methods: The CFs were collected under different treating temperatures from 1300□ to 2300□ every 100□. The micro-beam WAXD pattern was measured using a synchrotron X-Ray beam of wavelength 0.6199Å in the beam line BL15U at Shanghai Synchrotron Radiation Facility. The stabilized fibres were collected under different temperatures from 210□ to 250□ every 10□. The Photo-induced Force Microscopy measurements were performed to investigate the change in the functional groups in different radial positions of the fibre during the stabilization process.

Fig 1. (a) A diagram for micro-beam WAXD measurement. (b) Simplified schematic of the photo-induced force microscopy (PiFM) setup.

Results:

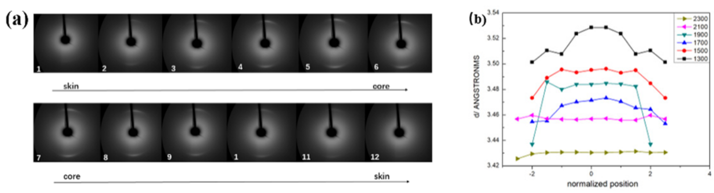

Fig 2. (a) WAXD patterns of different positions along radial direction in CF treated under 2300℃. (b) Distribution of d(002) along radial direction at various temperatures.

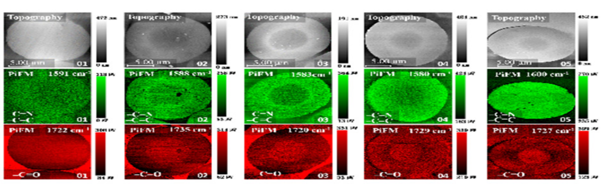

Fig 3. PiFM mapping of absorbance intensity at 1600 and 1730cm-1 for samples 01-05

O-050

Properties and Applications of Chopped glass fiber Reinforced PEEK Material in the Rocket Structure of the Spacecraft

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Abstract　The chopped glass fiber reinforced PEEK (SGF/PEEK) with different glass fiber contents was prepared by extrusion granulation technology. The effects of glass fiber contents and environment temperatures on the mechanical properties of the materials were studied. The length distribution of glass fiber and the microstructure of the material fracture by injection molding were also analyzed. The results showed that the mechanical properties of 30~35wt%SGF/PEEK were more excellent. With the increase of environment temperature, the strength and modulus of the material decreased gradually, while the notch impact toughness and elongation at break increased gradually. In addition, the residual fiberglass length distribution of 20wt% and 30wt%SGF/PEEK was 0.05~0.30mm, and the 40~60wt%SGF/PEEK was 0.10~0.40mm. In particular, for SGF/PEEK materials with 50wt% and 60wt%, the mass percentage reached more than 40% when the residual fiberglass length was 0.20mm.The microstructure of the fracture showed that the orientation of the glass fiber in the material was basically distributed in all directions, with good interface compatibility with PEEK resin matrix. Under the action of external loads, the glass fiber was pulled and even pulled out at different degrees, which was more obvious with the increase of the content of glass fiber. The 33wt%SGF/PEEK material was used to process the parts for the structure of the rocket body of spacecraft through injection molding. The product has light weight, high strength and low-temperature heat insulation, and has been applied in the field of aerospace engineering.

Key words　SGF/PEEK，Glass fiber content，Environment temperature，Residual fiberglass length distribution，Aerospace applications

O-053

Manufacture of high performance microcellular polymers by compression molding process foamed by supercritical carbon dioxide

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Supercritical carbon dioxide (CO_2) as blowing agent has attracted more and more attention because it is inexpensive, safe and environmentally benign. Compared with other commercial CO2 foaming polymer technologies, such as batch process in an autoclave for polymer beads production, injection foaming process and extrusion foaming process, compression molding process is a novel technology which can manufacture polymer microcellular board with good cell morphology, high expansion ratio and large-size outline dimension.

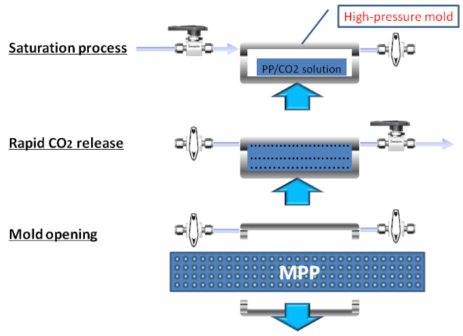

Figure Schematic of compression molding process foamed by supercritical CO2

Some strategies and approaches have been developed to broaden foaming temperature window, tailor the cell structure as well as improve foaming process efficiency. The industrial equipment with a capacity of 1000 ton/year has been built to produce microcellular polypropylene and microcellular thermoplastic polyurethane products. These products with uniform fine cells have excellent mechanical properties and have been exploited a lot of applications.

Keywords: Microcellular polymer foam; Supercritical carbon dioxide; Compression molding process

O-054

The roles of unspinnable fluids in creating electrospun polymeric nanostructures

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Introduction: The multiple-fluid electrospinning is investigated in creating complicated nanostructures.

Methods: Several examples are given to exhibit how to incorporate the un-spinnable fluids in the coaxial, tr-axial and side-by-side electrospinning processes.

Results: The modified multiple-fluid electrospinning are demonstrated to be useful in generating new core-shell nanofibers, manipulating the shells' thicknesses of core-shell nanostructures, producing Janus nanofibers with high quality, and developing the related novel drug delivery systems.

Discussion: The multiple-fluid electrospinning is more powerful than the traditional one-fluid blending process in two aspects. One is the potential treatment of un-spinnable working fluids, by which the great surface and huge porosity of nanofiber mat can be taken full advantages for the dispersed functional ingredients. The other is the new possibilities in creating novel and complex nanostructures. Additionally, the applications of un-spinnable fluids in multiple-fluid electrospinning can modify the working processes profoundly besides providing many new possibilities for developing novel polymeric nanostructures

Keywords: multifluid electrospinning, polymeric nanostructures, working solvent, unspinnable fluid

O-055

No damage laser welding of pfa and ptfe sheets

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Introduction:

Welding of different fluoroplastic has been performed by an Infrared laser. The feature is to achieve the overlap welding without deformation using a heat transfer technology: surface cooling and inside heating during laser illumination using a laser transparent heat spreading body. In this report the propriety of welding and its condition is ascertained by an experiment targeted for the welding of the different fluoroplastics as PFA and PTFE.

Methods:

Welding of PFA and PTFE sheets using a CO2 laser as a power source is performed and its propriety is observed by the cross-sectional observation of welded test pieces (optical microscope observation). Furthermore, an ingredient analysis by laser Raman microscope has been carried out. Then strength evaluation by tensile test was attempted.

Results:

Overlap welding of PFA(0.3mm) and PTFE(0.7mm) sheets without surface damage was succeeded.

The result of measurement of tension strength for PFA-PTFE sheets indicated equal to the one of welding of each PFA sheets. Further by Laser Raman microscope the result of measurement which can assume the dissolve of PFA and PTFE was obtained.

Discussion:

It was confirmed that laser welding of PFA and PTFE is possible by this method. The energy of the laser can raise temperature up more than both melt temperature in an instant. Pressurization of bulk sheets isn't necessary greatly, and their boundary seems fused by thermal expansion.

Keywords:

Laser welding, Fluoroplastics, Different plastics, Thermal control

O-056

Investigated on abnormal mechanism of Thermal protection coating

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Materials and process are key factors for supersonic & hypersonicairbornemissile project to realize advanced design goals. Irregular solidifying of epoxy thermal-protective coating on a batch of engines was studied. Main causes and influencers of humidity & temperature, materials utilization in working-shop, and time between sprays are cognized.

Key words: thermal-protective coating, solidifying，humidity & temperature，coat Material

O-058

The change on the filler dispersion in SBR/silica under cyclic uniaxial elongation by in-situ ultra small angle X-ray scattering

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Introduction: Addition of filler to rubber results in the improvement of the mechanical properties in the rubber/filler systems. The rubber/filler systems have been used widely in our daily life, such as tires, rubber insulators, and so on. Especially, the car tire is famous production used this system. Recently, from the viewpoint of the environmental problems and the depletion of fossil fuel resources, the high performance of tire is required. To achieve higher performance, it is important to investigate the relationship between the dispersion of filler in the rubber/filler system and the improvement of the mechanical properties. In this study, we focus on the relationship between the dispersion of filler in rubber and the stress. Therefore, we investigate the change with the dispersion of silica in SBR with uniaxial elongation by using in-situ USAXS and SAXS with a powerful X-ray source of SPring-8.

Methods: The rubber, which we used in this study, is Styrene-Butadiene Rubber (SBR, weight average molecular weight M_w = 500,000), and the filler is silica.SBR, silica and silane coupling agent (CA) were prepared by using Banbury mixer. Cyclic uniaxial elongation is imposed to the samples. Maximum strain is 100%, Frequency is 1.0Hz. X-ray experiment was conducted at BL03XU, SPring-8, JAPAN to experiment in-situ under uniaxial elongation.

Results: Figure 1 shows 2-D USAXS images in (a) SBR/Silica/CA at strain 0.0 and 1.0. Before elongation, the scattering image are isotropic. On the other hand, after elongation, the scattering image are anisotropic in direction of elongation. This anisotropy of scattering patterns is derived from inhomogeneity of silica's aggregates.

Discussion: In SBR/silica system, SBR is soft and silica is hard. Therefore, spatial inhomogeneity of stress field occurs. This means the part of SBR deform easier than the part of aggregate of silica. Under elongation, SBR region deform well. On the

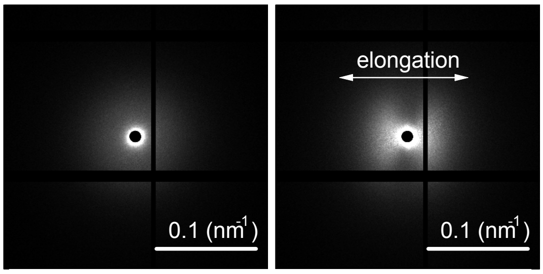

Fig.1 Scattering patterns of SBR/Silica with silane coupling agent at strain 0.0 and

O-059

Photocrosslinked poly(vinyl alcohol) (pva) /cellulose nanofiber (cenf) composites with high scratch resistance and transparency

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Introduction: Recently scratch resistance of the plastic or glass surface has been required to be improved for their application to the touch panels and smart phones. Addition of hard nano-particles such as silica (SiO2), alumina (Al2O3) and carbon nanotube (CNT) to the polymer composites have been studied and actually used for the improvement of scratch resistance. The mixtures of such nano-particles with polymer binders and cross-linking agents are usually coated on the glass or plastic substrates in order to improve the scratch resistance.

Cellulose nanofiber (CeNF) is a promising material for the improvement of scratch resistance, since it has high crystallinity and high modulus. Then the authors made clear that the use of CeNF and polycarbodiimide cross-linker (CL) was effective for the enhancement of pencil hardness (scratch resistance) of PVA composites, but not for its transparency [1]. In addition, it was found that the use of CeNF decreased the transparency of the PVA/CeNF/CL composites and their transparency depended on the species of CeNF and its dispersing agent [2]. In this paper the scratch resistance and transparency of the thin crosslinked PVA/CeNF composites prepared from the mixture of photocrosslikable PVA and thin CeNF will be discussed.

Methods: The photocrosslinkable water photopolymer aqueous solution (AWP-MRH), of which principal chain polymer was PVA, was supplied by TOYO GOSEI Co., Ltd. The thinner CeNF (CeNF-BB3) was prepared by the ultrasonification of CeNF-BB (CHUETSU PULP & PAPER CO., LTD) in water for 3hr. The mixture of CeNF-BB3 dispersion and AWP-MRH aqueous solution (CeNF conc.=0.00-0.50) was coated on the glass substrate and dried at 70 °C for 20 mins and treated with UV light of 365 nm for 2 min. The photocrosslinking reaction was checked by the disappearance of absorption peak at 2119cm-1 in ATR spectra. At that time the thickness of the photocrosslinked solids was adjusted to be around 1.5μm. Their scratch resistance (pencil hardness) was evaluated according to the pencil hardness test (JIS K5600-5-4). The larger the n number of pencil hardness (nH) is, the higher the scratch resistance is.

Results: The pencil hardness of photocrosslinked solids increased from H-2H to 4H with the increase of CeNF-BB3 to 40 wt%. Its excess addition (50 wt%) lowered a little the pencil hardness (3H-4H). The light transmittance of the photocrosslinked solids at 550nm was around 97%. There was little change in their light transmittance among the photocrosslinked solids.

Discussion: It was made clear that photocrosslinked CeNF/PVA solids prepared from CeNF-BB and AWP-MRH showed not only high pencil hardness (scratch resistance) and good transparency.

References

[1] S. Konagaya et al, Proceedings of AWPP 2015, 1-4th December 2015, Singapore.
[2] S. Konagaya et al, Proceedings of ICCM 21, 20-25th August 2017, Xi'an(China).

Keywords: Cellulose nanofiber, Poly (vinyl alcohol), Photocrosslinking, Pencil hardness, Scratch resistance

O-060

Cellulose nanofiber reinforced thermoplastic composites - from processing to performances

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Introduction: Cellulose nanofiber (CNF) have many useful properties, including high strength and low thermal expansion, and are also environmentally friendly, readily renewable, safe, and biodegradable. High performance CNF reinforced thermoplastics are developing in Kyoto Japan by accumulating special technologies of paper, chemical, polymer, polymer processing fields and their academia. In this presentation, representative and interesting data of our CNF reinforced plastics will be introduced. Methods: A paper pulp were treated by acetic anhydride in order to constrain hydrophilicity (for compatibility with plastics) and hydrogen bond (for easy to fibrillation in plastic), and improve heat proof. The acetic pulp and polymers were fed together in a twin screw extruder, and the shear and elongational stress induced nano-fibrillation of acetic paper pulp in molten plastics. The resulting materials of CNF/plastic composites were evaluated about practical characteristics such as bending, heat distortion temperature, coefficient of thermal expansion and recyclability. Results and discussion: The recyclability of CNF/polypropylene (PP) is only reported in this abstract due to limitations of space. Figure1 shows the bending stress-strain curves of CNF/PP composites which are kneaded with 1, 2 and 3 times by means of twin screw extruder, and then fabricated to bending test specimen. In general, fiber reinforced plastics is unsuited for material recycling, because reinforcing fibers are broken easily while kneading, as the results, the mechanical properties of fiber reinforced plastics terribly decrease. However, the developed CNF/PP composites with 3 times kneading maintained same bending properties of the CNF/PP composites with 1 time kneading. Figure2 shows SEM photographs of CNF extracted from CNF/PP composites with each kneading time. The fiber lengths and morphologies were similar even if the kneading times were different. Thus, the CNF composites can maintain the fiber length while material recycling. Keywords: Cellulose, Nanofiber, Pulp, Chemical treatment. Figure1 Bending stress-strain curves of CNF/PP composites kneaded with 1, 2 and 3 times. (Bending modulus-MPa, Bending strength-MPa) Figure2 SEM photographs of CNF extracted from CNF/PP composites with each kneading time.