



Bio-based Materials

2018 Asian Development Forum on Bio-based Materials

Bangkok· Thailand May 24-25, 2018



Conference Report

DT 新材料
NEW MATERIALS



Organization

Hosting Organization :

Bangkok Innovation Cooperation Center of Chinese Academy of Sciences
 Ningbo Institute of Materials Technology and Engineering, CAS
 Key Laboratory of Bio-based Polymeric Materials of Zhejiang Province
 DT New Materials

Supporting Organization :

Technology Innovation Alliance of Biobased Materials Industry
 National Innovation Agency (Thailand)
 Nova-Institut GmbH

Operating Organization :

Ningbo DT Research & Consulting Co., Ltd.

Co-operating Organization :

OSIC Internation (Thai) Co., Ltd

Sponsors :



Brief Information of Bio-based 2018

2018 Asian Development Forum on Bio-based Materials was held by DT New Materials, Bangkok Innovation Cooperation Center of Chinese Academy of Sciences (or the center for short), Ningbo Institute of Materials Technology and Engineering, CAS (or NIMTE for short) and Key Laboratory of Bio-based Polymeric Materials of Zhejiang Province in Bangkok, Thailand on 24-25th of May 2018. This is the first large-scale and high-quality seminar organized by NIMTE and DT New Materials about bio-based materials and products abroad.

The major supporting organizations were Technology Innovation Alliance of Biobased Materials Industry, National Innovation Agency (Thailand), nova-Institut GmbH and OSIC Internation (Thai) Co., Ltd. More than 100 well-known professors, distinguished scholars and executives from 70 units about bio-based materials and products were invited to attend the conference. The activities were greatly sponsored by m2p-labs GmbH, Cardolite Chemical (Zhuhai) Co., Ltd, Zhejiang Sodes New Material Co., Ltd, Arctic Biomaterials Oy, Guangzhou Bio-plus Materials Technology Co., Ltd and Thailand Convention and Exhibition Bureau.



Process and Significance of Bio-based 2018

In the morning of 24th May, the opening ceremony was hosted by Yifan Lin from Bangkok Innovation Cooperation Center of CAS. Hua Fan, associate director of the center and Jin Zhu, the deputy director of NIMTE and director of Key Laboratory of Bio-based Polymeric Materials of Zhejiang Province, respectively represented organizers to deliver the opening speech for the event. Mr. Fan thought highly of this forum, hoping to maintain a long-term cooperation with DT New Materials and build a communication platform to extend internal high-quality projects and techniques to Association of Southeast Asian Nations (ASEAN). Prof. Zhu mentioned the fundamental state of domestic study on bio-based materials, hoping our internal scholars can strengthen the communication with ASEAN with the help of this high-level platform.

In recent years, Chinese bio-based materials industry has developed rapidly with constantly breakthroughs of key technologies, increasing growth of product categories, enhanced economical efficiency of products,



Mr. Fan Delivered an Opening Speech



Prof. Zhu Delivered an Opening Speech



which has made bio-based materials become the hot spots in industrial investment. At the same time, bio-based materials industry also thrives in Southeast Asian countries where biomass resources are abundant. Thailand is definitely a leader in bio-plastics manufacture. With the implementation of the planned bio-based materials projects in Asian countries such as China, India and Thailand, Asia will be a new market leader in bio-based plastics.

NIMTE orient to new materials related industries and insist the target of transforming science and technology to productivity. Bio-based polymer is one of the important cultivated foreground of the institute. Prof. Zhu's group have obtained many breakthroughs in the bio fields in recent decades since they started the research in bio-based materials related fields in 2009, forming a certain extent influence in china. They also established extensive cooperation with some scholars and companies from America, Canada, Thailand and other countries. In 2017, the Key Laboratory of Bio-based Polymeric Materials of Zhejiang Province was formally set up, changing from overall layout to industrialization. To strengthen mutual exchanges, cooperation and innovation among countries along the B&R, the 2018 Asian Development Forum on Bio-based Materials is held by NIMTE. The topics of the forum are "Green materials, Win-win cooperation". It will promote the vigorous development of bio-based materials in Southeast Asian area and the world influence of Chinese scholars and entrepreneurs.

There are about 15 special reports during the forum, including global industry trends, Asian development conditions, Thailand policies and regulations, typical materials and building blocks (such as PLA, PHAs, PBS, Starch-based materials, PPC, Cellulosic materials, PEF, Lactic acid, FDCA, Cashew Nutshell Liquid). All the speakers are representative technical experts and industry elites. The organizing committee prepared certificates and exquisite gifts for each speaker.



Site of activity



Professor Meng and professor Yu issued the certificate and souvenir for Mr Michael



Group Photo



Brainstorming Discussion



A brainstorming discussion about bio-based products and bioeconomy is organized in the afternoon of 24th May. Michael Carus, Pipat Weerthaworn, Wolfgang Baltus, Marc Lankveld and Sangyong Kim were invited to participate the podium discussion, and Prof. Zhu acted as the host. These guests came from the representative countries and regions respectively, such as Germany, Holland, Thailand, China and Korea. The hot topics are global markets, development trends, policies and regulations, industry layout, and life style. The whole audiences thought highly of this discussion program.



Podium Discussion

Visiting and Communion



Group Photo

In the afternoon of 25th May, Prof. Zhu, Dr. K. Jim Jem and several other delegates visited Bangkok Innovation Cooperation Center of Chinese Academy of Sciences, who get a further understanding of the center's development situation and gave some constructive suggestions. This visit prefigured that NIMTE took an important step in international communication and cooperation.

Information of Speakers and Speeches



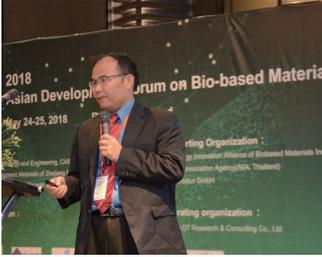
Michael Carus

Managing Director, Nova-Institut GmbH

Title: Trends, the big market and future conditions for bio-based materials

Abstract: The presentation will give a comprehensive overview on the world production capacities of bio-based building blocks and polymers from 2011 until 2017, including a forecast to 2022. The yearly growth (CAGR) rate for bio-based polymers is with 3 to 4% in the same range as petrochemical polymers, but differs as lot for different polymers. The CAGR for bio-based building blocks is higher, because the demand from food, feed and other sectors is growing fast. Market information on GreenPremium prices, applications and regions are included. It is expected, that packaging stays to be the most important sector and the highest growth rate are forecasted for Europe. Overall market data on the Bioeconomy in Europe are presented, the turnover of the bio-based chemicals sector in Europe is close to 50 Billion € per year.





Jin Zhu

Professor, Ningbo Institute of Materials Technology and Engineering, CAS

Title: Some progress on bio-based polymeric materials at NIMTE

Abstract: Bio-based polymers are a class of polymers which were made from renewable resources. Great attention has been paid from both academic and industrial society since they are sustainable and renewable materials. Some progress was made at Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences (NIMTE). This talk will review our research progress on heat resistant foam sheet of polylactic acid (PLA), furan based bio-based polyesters, and natural fiber composites.



Pipat Weerthaworn

Advisor, Plastics Institute of Thailand

Title: Policy and Direction of Bio-based industry in Thailand

Abstract: Thailand is the one of ASEAN countries, that has the wide investment in the bio-based industry probably due to Thailand has the abundant supply of biomass materials and agricultural products including sugarcane, rice, cassava, palm, and etc. Nowadays, Thailand is clearly at a leader of development in bio-based industry compared to other countries in South East Asia region. In addition, the model of “Thailand 4.0” focuses on the concept of inclusive, productive and green growth to enhance the country’s competitiveness and economic development leading to the encouragement of Bio-industry consisting of 4-categories, which are bio-energy (Bio-fuel), bio-chemical, bio-pharmaceuticals, and also bio-plastics. Moreover, The royal Thai government recognizes the importance of the sustainable economic development including Bio-based industry, the various policies have been introduced to address technological, economic and institutional challenges to move the country towards a sustainably green industry, such as the policy of Thailand’s New S-Curve, The National Bioplastics Roadmap, focusing on the development of R&D, supporting to the infrastructure and innovative businesses for bioplastics, Thailand’s National Biotechnology including a policy of Green Innovations for the critical industrial including Bioenergy and Bio-based Industries and the other important policies, that will be present in the details at this conference.





Wolfgang Baltus

Founder, Wobalt Expedition Consultancy

Title: Biorefineries in Asia - new development and challenges

Abstract: The presentation will give an overview about the status of Biorefineries in global context with focus on the development in Asia. The current market for bio-based chemicals is still small but expected to grow with a CAGR of around 5 % until 2022. In 2017 the total production capacities of relevant bio-based polymers was about 5 million tons, of relevant bio-based building blocks about 2.5 million tons. The economic development with low oil prices and policy changes, however, had a strong impact on the development and marketing of bio-based materials. Biorefineries and so called “Biohubs” are seen as a competitive way to develop these industries by combining biofuels, biochemical and biomaterials in a sustainable approach. Current concepts and policies, which include the integration of bio-based chemicals and the utilization of 2nd/3rd generation feedstock following the current global development trend, will be discussed on the example of selected Asian countries including Thailand, where Biorefineries are established for many years.

Long Yu

Director, Sino-Singapore International Joint Research Institute

Title: Development of Starch-based Materials: Used for Fertilizer Control Releasing



Abstract: Various fertilizers have been widely used in agricultures and horticultures. More than 400 million tons fertilizers are used in the world every year. However, fertilizer cannot be resealed in dry soil, and could be flashed out with heaven rain or irrigation without controlling into river, which results in polluting water resources. Actually, fertilizers have already coursed serious pollution for rivers and degeneration of land. Therefore, various controlled release fertilizers have been developed. This paper reviewed development of controlled release fertilizer based on both fundamental issues such as system designing and mechanisms, and materials used for coating as well as their fabrication. So far most of the materials used for coating are synthetic polymeric materials, such as PS, PE etc, which are not biodegradable. Environmentally friendly biodegradable coatings have attracted increasedly attention, but still in development stage in laboratory. On the other hand, dry and desertification are big challenges for agriculture in China. Using superabsorbent polymers as coating materials could add the function of keeping moisture for the fertilizer, which is particularly important for dry area. It is expected that the superabsorbent polymer coatings could be favorable for crops through helping seed sprout; increasing sprouting ratio, reducing irrigation and enhancing fertilizer efficiency etc. This presentation will introduce our work in developing starch-based slow/control releasing fertilizer.





Marc Lankveld

VP Innovation Platforms, Corbion

Title: FDCA, a promising key biochemical for Biobased polymers

Abstract: FDCA has been intensively researched for its unique properties in biopolymers since the last 15 years. Its unique gas barrier properties in PEF (Poly Ethyl Furanoate) makes it an excellent replacement for the petrochemical derived PET. This presentation shows Corbion's progress and capabilities in this field. The manufacturing route of FDCA, properties and applications of PEF and roadmap for further development will be presented.

Jun Zhang

Professor, Institute of Chemistry, Chinese Academy of Sciences
(Professor Zhu represented)

Title: Dissolution, Processing, and Functionalization of Cellulose with Ionic Liquids:
from Fundamental Research to Industrial Applications



Abstract: Cellulose is the most common organic polymer on the Earth, with an estimated naturally annual production of 1.5×10^{12} tons. However, processing and derivatization of cellulose are extremely difficult in general, because this natural polymer is neither meltable nor soluble in conventional solvents due to its hydrogen bonded and partially crystalline structure. During the past several years, our research focused on the green processing and functionalization of cellulose with ionic liquids (ILs), and our research achievements include following: We developed two series of imidazolium-based ILs, 1-allyl-3-methylimidazolium chloride and alkylimidazolium acetates showing powerful capability to dissolve cellulose. The dissolution mechanism of cellulose in ionic liquids was proposed. The rheological properties, aggregation, liquid crystalline structure, and crystalline behavior of cellulose dissolved in ILs were also demonstrated. Ionic liquids were successfully used to prepare regenerated cellulose materials, including fibers and films. Moreover, various functional cellulose materials and cellulose-based composites were prepared with the use of ILs. As a new kind of aprotic solvents, ILs were also used as the "green" reaction media for homogeneous derivations of cellulose, especially cellulose esterification.





K. Jim Jem

Greater China General Manager, Total Corbion PLA Ltd.

Title: Global Poly Lactic Acid (PLA) Industry and the Market Forecast

Abstract: PLA (Poly Lactic Acid) is an environmental friendly and sustainable plastic from bio-materials with high bio-efficiency and low carbon foot-print. Depending on the applications, PLA products can be fully degraded under the industrial composting conditions to reducing solid waste. PLA is rigid and cheaper than most other bio-plastics (e.g. PBAT, PBS, PHA, and PPC), but is more expensive than traditional petroleum-based plastics (e.g. PE, PP, PET). There are more and more regulatory and public pressure to use PLA and bio-degradable plastics to replace traditional non-bio-degradable oil-based plastics in disposable applications such as the PE mulch film (~1.4 million tons/yr in China), the e-commerce mail package (>1 million tons/yr in China), and the fast-delivered meal containers (>1 million tons/yr in China), not to mention the female hygiene products and disposable diapers, etc.

The global PLA market was estimated in 2012 by the “Jem’s Law” to double every 3-4 years (with a 25-33% annual growth rate), and has reached ~150 KT in 2017, mostly contributed by NatureWorks and Hisun. First generation PLA has less desirable mechanical and physical properties, which limit its commercialization to only the low-end and/or mid-temp applications such as disposable cutlery and room-temp food containers. The second generation, high optical purity PLLA (from L-lactic acid) and PDLA (from D-lactic acid, at ~3x price) allows fast crystallization and improved mechanical/thermal characteristics for previously unattainable high-end, higher-temp, and/or semi-durable applications.

Liming Zhao

Professor, East China University of Science and Technology

Title: Biological manufacture and application of bio-based polybutyrolactam



Abstract: Polybutyrolactam, one kind of linear polybutyrolactam macromolecule polymerized from monomers butyrolactam, also known as polyamide 4 (PA4). It is a kind of translucent or milky thermoplastic resin with relative density of $d=1.22$ to 1.24 and melting point of 260 to 265°C . It can solute in zinc chloride or other inorganic salt solutions at room temperature as well as superheated water. Polybutyrolactam can be decomposed at 100°C in 0.1 mol/L sodium hydroxide or hydrochloric acid. Polybutyrolactam has better thermal stability than other polyamides. It has a similar hydrophilic property with cotton and silk, however, a better abrasion resistance than them. Artificial leather made from polybutyrolactam has elasticity and porosity without static electricity. It can be processed into plastic products by injection molding and extrusion. Unlike almost other polyamide products, PA4 has excellent biodegradability and can degrade in the natural environment. Now, the use of renewable bio-based raw starch sugars in bio-based PA4 production can solve the raw material problem of large-scale production of PA4. The use of bioconversion processes instead of chemical reaction processes under high-temperature and high-pressure can greatly reduce production costs. Thus PA4 can be used more extensive and easier.





Fabien Resweber

Vice-President Sales & Marketing, PTT MCC Biochem Company Ltd

Title: Open-up new possibilities with BioPBS, versatile solution for bioplastics innovations

Abstract: PTTMCC is a strategic joint venture between PTT Global Chemical Public Company Limited (PTTGC) and Mitsubishi Chemical Corporation (MCC) with the intention to focusing solely on the bio-chemical industry and creating products of benefit to mankind and to build a greener world. Consequently, PTTMCC is determined to produce bio-chemical products that will initiate changes for a better future. We have launched our first project with the Polybutylene Succinate (PBS) Plant in Thailand, which is also the first biggest bio-based PBS plant in the world. BioPBS (bio-based polybutylene succinate) is revolutionary in its two-fold bio properties. It is both bio-based and biodegradable plastic, using advanced technology from Mitsubishi Chemical Corporation. Derived from natural resources, such as sugarcane, cassava and corn, BioPBS is naturally compostable without composting facility into biomass, carbon dioxide and water to be used for plant growing repeatedly. BioPBS is the only PBS approved by FDA with FCN number 1817 and 1818, and is also EU10/2011 certified, making its use easy for any global brand. Its excellent heat sealability, heat resistance up to 100°C, good adhesion with cellulose and natural fillers, and similar processability to LDPE allows a multipurpose use in food packaging application.

Yuezhong Meng

Professor, Sun Yat-sen University

Title: Chemically Application of Carbon Dioxide for Biodegradable Plastics and Other Fine Chemicals



Abstract: Carbon dioxide is considered as the environmental pollutants that cause the climate warming or greenhouse effect. Among these gases, carbon dioxide contributes more than 66% for this effect. Therefore, the reduction of massive gas release into the atmosphere has attracted considerable attention of the scientists all over the world. On the other hand, environmental pollution associated with the plastic waste disposal has also attracted much attention to develop new degradable materials. We called this problem as “white-pollution”. From the viewpoints of economy and ecology, the application is to use carbon dioxide as a monomer to synthesize biodegradable polymers and other chemicals. In this lecture, we will first introduce the new biodegradable polymer and the catalysts for its synthesis, and consider the biodegradable polymer to be developed to meet the demands of practical applications as a common thermoplastic. In the second part we will focus on the properties and the modification of this new biodegradable material, and the technology both in terms of process and cost. We will then present the state of the art of the different materials under commercialization and the perspective of future developments.

The new biodegradable plastic has been commercialized in Tian-Guan Enterprise (Group) Co. Ltd, Henan Province of China at a scale of 25,000t/a. Tianguan Group is a big company of the new-type agricultural product processing bases





with production capacity of 800 thousand tons of fuel alcohol, however, the company simultaneously yields almost equal amount of by-product of carbon dioxide as a waste gas. In this sense, the usage of carbon dioxide is an impendency issue because the massive release of carbon dioxide into atmosphere is considered as environmental pollutant. Therefore, the company utilizes the carbon dioxide as a starting reactant to produce biodegradable polymers. In this sense, this technology, by converting industrial waste into a high value-added biodegradable plastic, is typically regarded as “One stone kills two birds”.



Marcel van Berkel

VP Sugar Delta, Stichting Biobased Delta

Title: Fermentation opportunities in the Sugar Delta of Europe

Abstract: Biobased Delta is the first Public-Private Partnership developing an eco-system for the Circular Bioeconomy. The Biobased Delta focuses on green chemistry in order to facilitate the transition to the Circular Bioeconomy. The cooperation between knowledge institutions, government bodies and the industry (SME and multinationals) is crucial in this

Top 3 milestones Biobased Delta has achieved in the past 3 years:

- foundation of the Biobased Delta in 2012
- co-creation of 5 top knowledge/innovation centers in the area, including: centers for biopolymers, natural fibres, natural colors and the Green Chemistry Campus
- initiation of 3 Flagship projects: Sugar Delta (valorisation of sugar), Redefinery (large-scale biorefinery), Biorizon (bio-aromatics).

Top 3 milestones Biobased Delta target to achieve in the next 3 years:

- 3 New business initiative using biomass/sugar feedstock
- Concept Engineering large-scale bio-refinery
- Market introduction of bio-aromatics

Matthias Chua

Sales Director, China & SEA, Cardolite Corporation

Title: Renewable, Non-Food Source, CNSL Based, Bio Polymers



Abstract: Cardolite is committed to help reduce the dependence on fossil fuels, through continuous scientific research and development, to create our expanding portfolio of next generation, renewable, non-food source, CNSL (Cashew Nutshell Liquid) based bio polymers, for your development needs.





Teng Li

Co-founder and CEO of Bluepha Co., Ltd. Beijing, China

Title: Low-cost PHA bioplastic production processes

Abstract: Bluepha is a Chinese biotech company based on synthetic biology innovations originally developed in and transformed from Tsinghua University, Beijing, China. Bluepha reprogram microorganisms using synthetic biology tools to produce bio-products or to improve the efficiency of existing bioprocesses. P(3HB-co-4HB), a kind of PHA biomaterial, is the first product of Bluepha. Using the unique halophilic microorganism *Halomonas bluephagenesis* TD found in a salt lake in China, a non-sterile open fed-batch fermentation process was developed and tested in pilot- and industrial-scale for low-cost P(3HB-co-4HB) production. A high yield of P(3HB-co-4HB) can be achieved within 36 hours in a 5-m³ pilot-scale fermenter. Several applications had been developed using P(3HB-co-4HB) produced such way. This material showed good properties, especially its flexibility, for different end-user applications. Bluepha is co-founded by Dr. Teng LI (CEO, the speaker), Dr. Haoqian ZHANG (CTO), and Prof. George Guo-qiang Chen of Tsinghua University (Chief Scientist).

Sangyong Kim

Director of Renewable Chemical Center, Korea Institute of Industrial Technology

Title: Biobased Diacids and Furans as Core Building Blocks for Bioplastics



Abstract: Biobased platform chemicals as alternatives to petroleum derived chemicals are getting major attention from industries in an expectation to substitute non-renewable material supply chains for sustainable biobased economy. Among targeting product lines, biobased monomer precursors and copolymers stand front of emerging market backed by industrial thrust based on green market expectation. KITECH has focused on the establishment of production technology platform of biobased building blocks such as isosorbide, diacids, furans and their derivatives as co-monomers leading to performance copolymers and derivative products such as fibers and composites. The presentation will introduce relevant overall research progress along with future expectation in terms of target biomaterials, green processing and optimal integration towards bioplastic production.



Participation Units (part)



Bangkok Innovation Cooperation Center of CAS	Nova-Institut GmbH
East China University of Science and Technology	Plastics Institute of Thailand
Zhongshan Mingfeng Biodegradable Plastics Co., Ltd	Thai Bioplastics Industry Association
HOTO Holding Group Co.,Ltd.	Institute of Chemistry, CAS
Advanced Biochemical (Thailand) Co., Ltd.	National Innovation Agency
Thai Association for Biotech Industries	Sun Yat-sen University
Weihai Liangan biomaterials technology Co., Ltd	Wobalt Expedition Consultancy
Korea Institute of Industrial Technology	Corbion
Dalian University of Technology	Tsinghua University
South China University of Technology	PTT MCC BIOCHEM CO., LTD
Cardolite Chemical (Zhuhai) Co., Ltd	DOW Chemical Company
Zhejiang Sodes New Material Co., Ltd	Total Corbion PLA Co., Ltd.
National Starch and Chemical (Thailand) Ltd	Arctic Biomaterials Oy
Norwex China Co., Ltd	Covestro
P.S.C. STARCH PRODUCTS PCL.	Stichting Biobased Delta
HMC Polymers. Co. Ltd	TOYOBO Co., Ltd
Ampacet (Thailand) Co.,Ltd	m2p-labs GmbH
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OSIC Internation (Thai) Co., Ltd	BBGI Public Company Limited
Ningbo Institute of Materials Technology and Engineering, CAS	
Sino-Singapore International Joint Research Institute	
National Science and Technology Development Agency	
Guangzhou Bio-plus Materials Technology Co., Ltd.	
HI-TECH Bio-Based Materials Engineering and Technology (Ningbo) Co., Ltd.	
Jiangsu Jinlong-CAS Enviromental Protection New Materials Co., Ltd	
Thailand Institute of Scientific and Technological Research	
Zhe Jiang MingJiang New Material Technology Company Limited	
Shenzhen Prosperous New Material Technology Co.,Ltd	

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