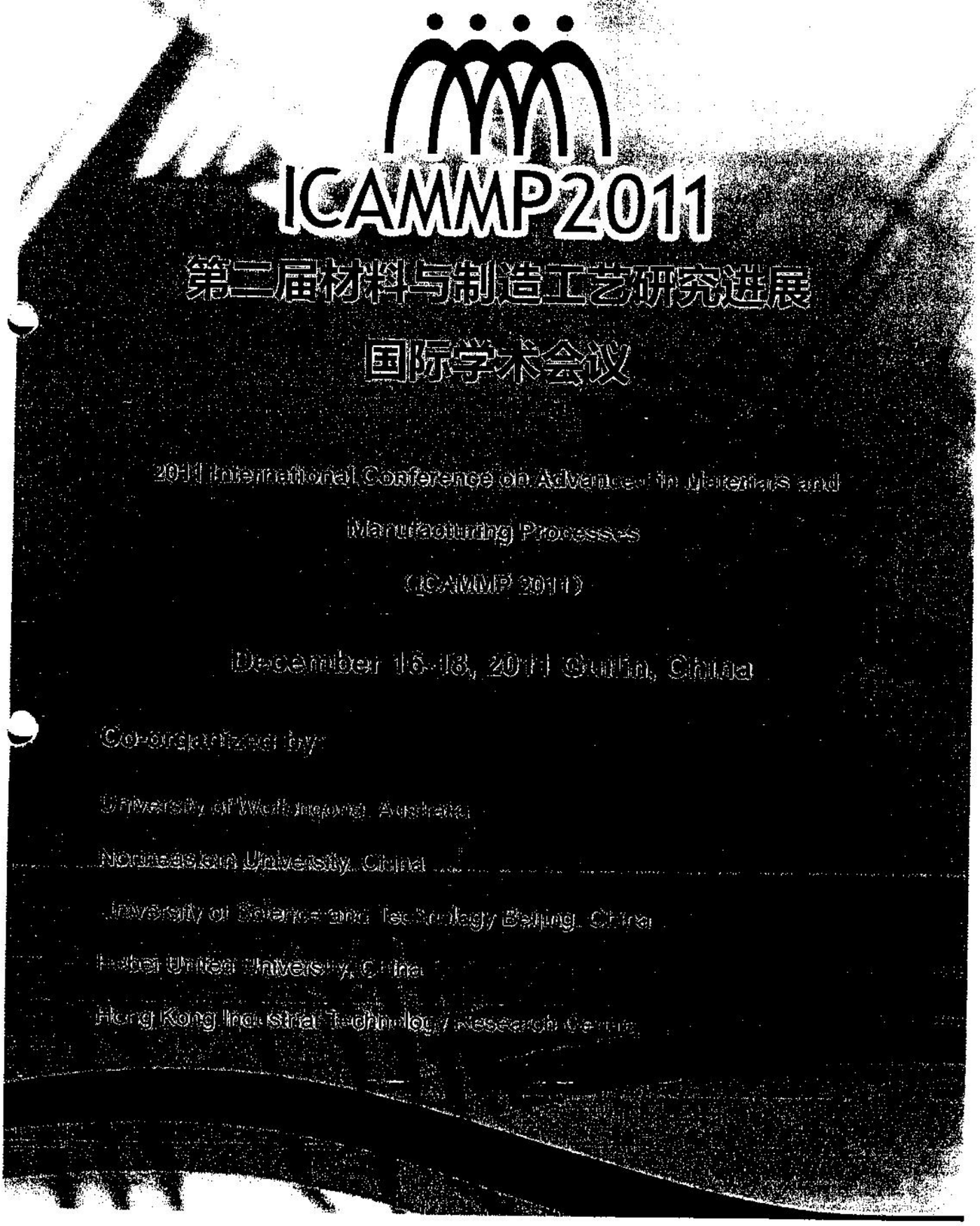


ICAMMP2011

第二届材料与制造工艺研究进展国际学术会议

2011 International Conference on Advances in Materials and Manufacturing Processes

(ICAMMP 2011)

December 15-16, 2011 Guilin, China

Co-organized by:

University of Wollongong, Australia

Northeastern University, China

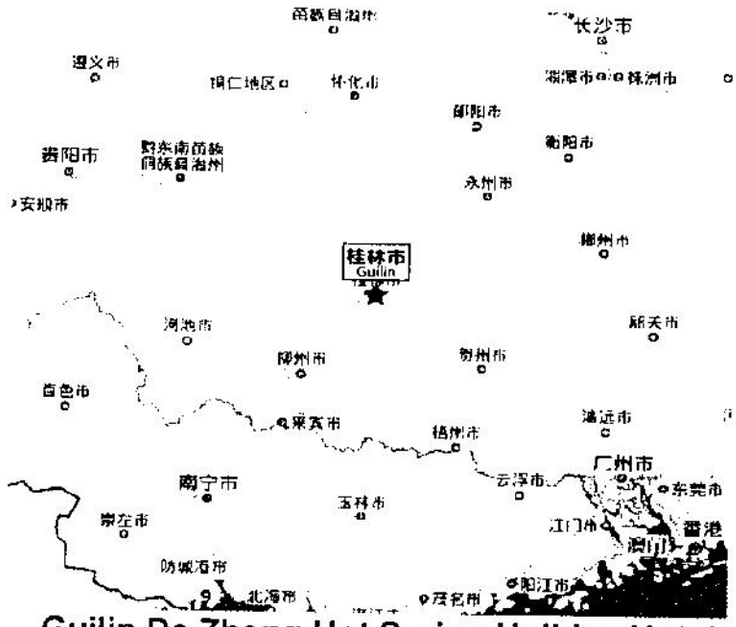
University of Science and Technology Beijing, China

Hubei United University, China

Hong Kong Industrial Technology Research Centre

CONFERENCE MAP GUIDE

Guilin, China



Guilin Da Zheng Hot Spring Holiday Hotel

ICAMMP 2011 SECRETARIAT

Any question, please contact the secretariat: +86 13826049112

The Second International Conference on

Advanced in Materials and Manufacturing Processes

(ICAMMP 2011)

Co-organized By:

University of Wollongong, AU

Northeastern University, China

University of Science and Technology Beijing

Hebei United University, China

Hong Kong Industrial Technology Research Centre

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Prof. Zhengyi Jiang, University of Wollongong, AU

Prof. Xianghua Liu, Northeastern University, China

Prof. Jingtao Han, University of Science and Technology Beijing

Prof. Sihai Jiao, Research Institute, Baosteel, China

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Prof. Yun-Hae Kim, Korea Maritime University, Korea
Prof. Yu-Shiang Wu, China Univerisity of Sci. and Tech., Taiwan
Prof. Heinz-Gunter, Brokmeier, Technische Universitat Clausthal,Germany
Prof. Zhengyi Jiang,University of Wollongong, Australia
Prof. Yun-Hae Kim, Korea Maritime University, Korea
Prof. Christian Kloc, Nanyang Technological University, Singapore
Prof. Jacques Noudem, CRISMAT laboratory, France
Mr. Mohammad Hadi Hafezi, National university of Malaysia, Malaysia

Conference Website

http://www.icammp.org

SCHEDULE OF THE CONFERENCE

December 16 (Friday)

10:00—21:00
Registration, Sequence Hall, Guilin Da Zheng Hot Spring Holiday Hotel
12:00—13:00
Lunch, Aurantiacus Chinese Restaurant,1/F（丹桂轩）
18:00—19:30
Dinner, Aurantiacus Chinese Restaurant,1/F（丹桂轩）①

December 17 (Saturday)

8:30—8:40
Open Ceremony, Ballroom, 3/F (大正厅)
8:40—9:55
Keynote Speeches
9:55—10:15
Tea Break
10:15—11:30
Keynote Speeches
12:00—
Lunch, Aurantiacus Chinese Restaurant, 1/F ②
14:00—15:30
Parallel Sessions (A, B, C)
15:30—15:50
Tea Break
15:50—17:20
Parallel Sessions (A, B, C)
18:00—18:40
Dinner, Aurantiacus Chinese Restaurant, 1/F ③

December 18 (Sunday)

8:30—10:00
Parallel Sessions (A, B, C)
10:00—10:20
Tea Break
10:20—11:50
Parallel Sessions (A, B, C)
12:00—
Lunch, Aurantiacus Chinese Restaurant, 1/F ④

Morning, December 17, 2011

Plenary Session (8:30 AM—11:30 AM)
Ballroom, 3/F (大正厅)

Chairmen

Prof. Zhengyi Jiang, University of Wollongong, AU

Prof. Xianghua Liu, Northeastern University, China

Prof. Jingtao Han, University of Science and Technology Beijing

Prof. Sihai Jiao, Research Institute, Baosteel, China

Prof. Jinglong Bu, Hebei United University, China

8:30—8:40 Opening Speech

8:40—9:05 Plenary

Prof.J ingtao Han,U niversity of Science and Technology Beijing, China

9:05—9:30 Plenary

Prof.X ianghua Liu,N ortheastern University, China

9:30—9:55 Plenary

Prof.S ihai Jiao,R esearch Institute, Baosteel, China

9:55—10:15 Tea Break

10:15—10:40 Plenary

Prof.X ungai Wang, Deakin University, Australia

10:40—11:05 Plenary

Prof.Z hengyi Jiang, University of Wollongong, Australia

11:05—11:30 Plenary

Prof.T suyoshi FURUSHIMA, Tokyo Metropolitan University, Japan

12:00— Lunch

Afternoon, December 17, 2011

14:00 PM—17:20 PM

Session A: Advanced Materials

1/F VIP Building, Tuoyuan Room (贵宾楼驼园厅)

Chairmen: Prof. Woei-Yun Ho, Mingdao University, Taiwan

Prof. Guang Xu, Wuhan University of Science and Technology, China

(12 minutes for each presentation, including 2-3 minutes of answering questions)

1. Dielectric and Ferroelectric Properties of (K0.5Na0.5)(Nb1−xVX)O3 Ceramics (N2477)
   Yanmin Huang,L aijun Liu,D anping Shi,S haoying Zheng, Shuangshuang Wu

2. Effect of Envelope Films on Thermal Properties of Vacuum Insulation Panels with Glass Fiber (N2742)
   Wangping Wu, Zhaofeng Chen, Jieming Zhou and Xueyu Cheng

3. Decolorization of Coking Wastewater by Mineral Adsorbents (N1844)
   Kaining Yu,C heng Wang, Yang Yu, Yan Li

4. Failure Analysis of the Stuffing Box in a Super High Pressure Compressor(N2185)
   Xiaohui Li, Yiliang Zhang, Xuedong Xu

5. Secondary Hardening during Tempering of Cr-W-Mo-V High Alloy Medium-Upper Carbon Steel and its Hardness Forecast(N1327)
   Yongqing Ma, Hongtao Gao, Yufen Liang, Xiaojing Zhang

6. Study the Non-Linear Heat-Elasto-Plastic Constitutive Relation (N1524)
   Xiaojiu Feng, Lifu Liang, Siyuan Wang

7. Fully Automatic Wafer-Scale Micro/Nano Manipulation Based on Optically Induced Dielectrophoresis (N2176)
   YanLi Qu , Maijuan Zheng, Wenfeng Liang, Zaili Dong

8. Fabrication and Thermoelectric Properties of Magneli Phases by Adding Ti into TiO2 (N2316)
   Yun Lu, Yusuke Matsuda, Katsuhiro Sgara, Hao Liang,T akahito Otomitsu, Hiroyuki Yoshida

9. Fabrication of TiO2/Cu Composite PhotocatalystT hin Film by 2-Step Mechanical Coating Technique and its Photocatalytic Activity (N2317)
   Yun Lu, Liang Hao, Keisuke Toh, Hiroyuki Yoshida

10. Extraction Feature of Gas Flucturation of Guideway System Based on the Wavelet Transform (N2291)

Dongju Chen, Jinwei Fan, Feihu Zhang

11. Low Temperature Fabrication of Platinum/Carbon Black Powder Coating (N3089)
Phuri Kalnaowakun

12. Nonlinear Constitutive Equation and Elastic Constant of Rubber Material (N2043)
Li Chen,Z hao Li

13. Phase-Field Model for Spinodal DecompositionofD ilute Solute Field in Al-Ag Alloy (N1390)
Yingjun Gao, Zhirong Luo

14. The Time Response of Exponential Doping NEA InGaAs Photocathode Applied to near Infrared Streak Cameras (N1961)
Weidong Tang, Chuandong Sun, Wenzheng Yang, Zhipeng Cai

15. Theoretical Energy Distributions of Electrons from a Large Exponential-Doping GaAs Photocathode (N2178)
Zhipeng Cai, Weidong Tang,W enzheng Yang, Xun Hou

16. The Effect of Bainitic Transformation on Martensite Start Temperature of a Fe-C-Mn-Si Alloy (N1732)
Guang Xu, Hang Zou,C onghua Bu

17. Corrosion Behavior of CrN/AlSiN Multilayer Coatings on AISI 304 Stainless Steel in Aluminum Alloy Melt(N1731)
Wei-Yu Ho, Chia-Hang Tsai, Cheng-Hsun Hsu, Woei-Yun Ho

18. Preparation and Mechanical Properties of a Bulk Icosahedral Quasicrystalline Ti-Zr-Sc-Ni Alloy (N2419)
Xinlu Wang, Wanqiang Liu, Shanshan Zhang, Limin Wang

19. Characterization of LiClO4-SiO2 Composite Electrolyte Prepared by Modified Sol-Gel Method (N1634)
Hafizul Mat, Nor Sabirin Mohamed, Ri Hanum Yahaya Subban

20. Preparation and Characterization of Ag Nanowires by Hydrohermal Method (N2108)
Ligang Liu,Z hiqiang Wei,X iaojuan Wu, Ge Zhang

Afternoon, December 17, 2011

14:00 PM—17:20 PM

Session B: Materials Processing Technology

3/F The First Meeting Room (大正 1 号会议室)

Chairmen: Prof. Mont Kumpugdee Vollrath, University of Applied Sciences Berlin, Germany

Prof. Cheng Zhao, Tongji University, China

(12 minutes for each presentation, including 2-3 minutes of answering questions)

1. A Study on Brazing Process and Mechanical Properties ofA Z31 Magnesium Alloy (N1310)
   Xian Xie, Gaofeng Quan, Xiue Gu,X ingming Liu, Jiale Sun

2. Ergonomic Analysis of the Master of Minimally Invasive Surgical Robot (N3539)
   Qingbo Zhang, Chen Zhao,X iaoming Luo

3. An Approach to Analyze Pose Accuracy of Master Slave Surgical Robot with Matlab (N3541)
   Jianye Zhang, Wei Wang, Chen Zhao, Heng Zhang

4. Effect of Currento n the Interfacial Structures of the Dissimilar Metals Diffusion Bonding (N1706)
   Lifang Hu, Fuming Wang,S haoping Chen, Qingsen Meng

5. Research Analysis and Experiment Study on Flow Field of Hydrodynamic Coupling (N3677)
   Rui Zhang,C hengjian Sun, Yue Wang

6. Semi-Continuous Extraction of Agarwood Oil with Subcritical Water: Optimization of Plug Flow by Response Surface Methodology (N3595)
   Aunyarut Apibalsri, Supawan Tantayanont, Somkiat Ngamprasertsith

7. A New Approach for Colloidal Crystal Fabrication with the Template of Reversible Stress Wrinkle (N3626)
   Qing Xu, Zhaoting Yang, Chaorong Li, Benyong Chen,W enjun Dong

8. Picosecond Laser Microstructuring for Black Silicon Solar Cells (N3303)
   Xiaoning Zhu, Hongliang Zhu, Dewei Liu, Yongguang Huang, Xiyuan Wang, Haijuan Yu, Shuai Wang,X uechun Lin, Peide Han

9. Evaluation of Non-Uniform Deformation of Multi-Layered Ceramic Sheets with Printed Electrodes during Compression (N2703)
   Fumio Naruse, Naoya Tada

10. The Learning Styles of Taiwanese Mechanical Engineering Students (N3350)
Chin Min Hsiung, Chichang Lin

11. Preparation of Three-Dimensional Ordered Macroporous Perovskite-Type LaFeO3 Oxides (N2977)
Kun zhao,F ang He,X inai Li,Z hen Huang, Haibin Li

12. The Assembly Success Rate and the Estimation of Assembly Time for a Flexible Assembly System (N3566)
Jun Wang, Zhijun Yao,Z hi Guo

13. Classification of Fresh N36 Pineapple Crop using Image Processing Technique (N2887)
Shuhairie Mohammad, Kamarul Hawari Ghazali, Nazriyah Che Zan, Siti Sofiah Mohd Radzi, Rohana Abdul Karim

14. Increasing Solubility of Poorly Water Soluble Drug Resveratrol by Surfactants and Cyclodextrins (N3460)
Mont Kumpugdee-Vollrath, Yvonne Ibold

15. Effect of Ce Addition on the Microstructures and Mechanical Properties of a Ni-Co-Based Superalloy (N1605)
Chuanyong Cui, Guoming Han,X iaofeng Sun

16. Evaporation Characteristics of Ammonium Formate-Urea-WaterS olution Droplet forS CR Systems (N2340)
Seung Yeol Lee, Seung Wook Baek

17. Experimental Observation on the Uniaxial Cyclic Deformation Behaviour of TA16 Titanium Alloy (N1868)
Qianhua Kan,W enyi Yan, Guozheng Kang

18. Synthesis and Characterization of Siloxane-Modified Polyurethane Dispersion/Clay Nanocomposites (N3175)
Heun Hyo Noh, Jong Keun Lee,X ing Liu, Yong Man Choi

19. A New Interwell Tracer Technology ---Particle Tracer Technology (N1564)
Yifei Liu

Afternoon, December 17, 2011

14:00 PM—17:20 PM

Session C: Advanced Manufacturing Technology

2/F The Third Meeting Room (大正 3 号会议室)

Chairmen: Prof. Abel Cherouat, University of Technology of Troyes, France

(12 minutes for each presentation, including 2-3 minutes of answering questions)

1. Effects of a High Magnetic Field on the Solidification Behavior of Binary Al-Si and Ag-Cu Systems (N2563)
   Tie Liu, Qiang Wang, Hongwei Zhang, Guojian Li, Keiji Nakajima,J icheng He

2. Key Issues in Microscale Temperature Sensing with Thermocouple Array (N2139)
   Weiqiang Sun,H aixiao Liu, Shengyong Xu

3. GaN-based LEDs grown on cone-shaped patterned sapphire substrates with peripheral air voids by lateral etching (N2374)
   Nan Ming Lin, Shih Chang Shei, Shoou Jinn Chang, Wei Chih Lai, Ya Yu Yang, Wun Cin Lin, Hsin Ming Lo

4. Finite Element Simulations of the Sinus Lifting Process (N1432)
   Ching-Chieh Huang, Li-Wen Chen, Nan-Ming Yeh, Wu Dong-Feng,Y ung-Chuan Chen

5. Mechanical Bending Simulation of Thin Stainless Steel by Using Isotropic and Orthotropic Properties (N2461)
   Somsak Siwadamrongpong,U sanee Kitkamthorn,C haiyapak Sajjawattana

6. Realization of a Prototype System for Point Cloud Data Processing in Reverse Engineering (N1141)
   Yong Zhuo, Juan Peng,Y anjun Wu

7. Observer Design and Stabilization for a Class ofS witched System (N2008)
   Ming-Yuan Shieh, Juing-Shian Chiou

8. Phase-Field Numerical Simulation of Pure Free Dendritic Growth Using Wheeler and Karma Model (N2021)
   Yun Chen,N amin Xiao, Xiuhong Kang, Dianzhong Li

9. A Comparison of Cover Coat Methods for Electronic Flexible Printed Circuit (E-FPC) Based on Peeling Strength (N2498)
   Sirisak Rangklang, Paphakorn Pitayachaval, Suradet Tantriratn,J iraphon Srisertpol

10. Strain Hardening Analysis Coupled to Remeshing Procedure Application to Sheet Hydroforming Processes (N3426)

Faouzi Slimani, Abel Cherouat, Mahfoudh Ayadi, Mohamed Ali Rezgui

11. Modification Method by Increasing and Decreasing Elements in the Emergent Design System (N2403)
Akira Kito, Yuki Mizumachi, Mitsuhiro Sekiguchi, Koichiro Sato, Yoshiyuki Matsuoka

12. Mechanical Properties of Aluminium-Alumina Welding by Friction Welding (N3675)
Tummasook Mingmuang,S ukangkana Lee,C hawalit Thinvongpituk

13. Inhibited and Enhanced Spontaneous Emission Using Silicon-Based on Finite Thickness Photonic Crystal Waveguides (N3601)
W. Amorntep, P.W anchai

14. Simulation and Experimental Measurement of Ultrasonic Waves Propagation Velocity in Trabecular Bone (N3699)
Abderrazek Bennamane, Tarek Boutkedjirt

15. Optimization of Diamond-Coated Drawing Dies for Stainless Steel Tubes Based on the FEM Simulation (N3543)
Zichao Lin,B in Shen,F anghong Sun, Zhiming Zhang, Songshou Guo

16. Investigation and Evaluation of the Safety Properties of Hardwood Athletic Floor System in China (N3581)
Yuping Zhang,L imin Peng, Bin Lv, Feng Fu

17. Wear Resistance Improvement of Titanium Bearings by Laser Gas Nitriding (N3725)
Edson Costa Santos, Katsuyuki Kida, Justyna Rozwadowska, Takahashi Honda, Hitonobu Koike , Yuji Kashima, Kenji Kanemasu, Ryo Matsumoto

18. Epitaxial Growth of Ni-Based Superalloys Using Laser and Spark Deposition (N3728)
Edson Costa Santos, Katsuyuki Kida, Justyna Rozwadowska,M asaaki Kidera, Changjun Chen

Morning, December 18, 2011

08:30 AM—11:50 AM

Session A: Advanced Materials

1/F VIP Building, Tuoyuan Room (贵宾楼驼园厅)

Chairmen: Prof. Ning Fang, Utah State University, USA

Prof. Sutham Niyomwas, Prince of Songkla University, Thailand

(12 minutes for each presentation, including 2-3 minutes of answering questions)

1. Microstructure Characterization of Al Nanoparticles Prepared by Anodic Arc Plasma (N2814)
   Zhiqiang Wei,X iaojuan Wu,L igang Liu, Ge Zhang

2. Application of Benzyl Ester of Modified Vegetable Oils as Rubber Processing Oils (N2505)
   Hasleena Boontawee, Charoen Nakason, Azizon Kaesaman, Anoma Thitithammawong, Sopa Chewchanwuttiwong

3. The Biocompatibility and Bioactivity of Gradient Composite Bioceramic Coating with Different Content of Nd2O3 Fabricated by Wide Band Laser Cladding (N2118)
   Ming Xiao, Qibin Liu, Yizhi Zhu

4. The Influence of the Residual Mg Content in theD uctile Cast Iron on the Formation Law of Spherodial Graphite (N2117)
   Zhiqing Shen, Hongliang Zheng, Tongtong Li, Yan Xu, Rongfu Xu, Xuelei Tian

5. Effect of Cating Design to Microstructure an Mechanical Properties of 3 Mm TWDI Plate (N1695)
   Johny Wahyuadi Soedarsono,B ambang Suharno, Rianti Dewi Sulamet-Ariobimo

6. The Synthesis and Characterization ofN adic Dialkyl-Ester Derivatives with Trialkyl Borate (N3181)
   Yiwen Jin,JunSeong Park, Yong Sung Park,J e-Wan Woo

7. Influence of Laser Power on the Microstructure and Anti-Corrosion Performance of LHPS NiCrAlY Coatings (N1884)
   Shuqing Li, Shuili Gong, Yuping Duan, Shunhua Liu

8. Effect of Casting Velocity on Microstructures of AlMg0.9Si0.7 Alloy by Low-Superheat DC Casting (N2199)
   Dazhi Zhao, Fuxiao Yu, Fang Liu, Kezhun He

9. Developmento f Processing Maps for Coiled Tubing Steel (N2132)
   Zhendong Zhang, Haitao Zhou，Xianghua Liu, Sijun Li, Jie Dong, Xiao Zhou

10. Organic Light Emitting Diodes with Metallocene Compounds as Cathode Interfacial Layers (N2308)
    Keunhee Park, Donghyun Yeo, Seungsik Oh, Hoonbae Kim, Myung Hoon Ha, Hyojin Oh, Minwoo

Park,J isoo Park, Daewon Park,D onggeun Jung,H eeyeop Chae,H youngsub Kim, Jin-Hyo Boo

11. Performance Enhancement of Organic Solar Cells with the LiF/Al Cathode Structure by the Pyromellitic Dianhydride Layer (N2306)
Seungsik Oh, Donghyun Yeo, Keunhee Park, Hoonbae Kim, Myung Hoon Ha, Hyojin Oh, Minwoo Park, Jisoo Park, Daewon Park, Donggeun Jung, Heeyeop Chae, Hyoungsub Kim, Jin-Hyo Boo, Eunkyoung Nam

12. Tensile Properties of Hot Extruded Mg-Zn-Nd-Y-Zr Alloy at Elevated Temperatures (N2133)
Xiao Zhou, Haitao Zhou, Zhendong Zhang, Ruirui Liu, Libin Liu

13. Characteristics of Two-Stage Γ -Gate on AlGaAs/InGaAs/AlGaAs DH-HEMTs by Using AlGaAs/InGaP Etching-Stop Layers (N2522)
Jia-Chuan Lin, Meng-Kai Hsu,F u-Xiang Zeng, Jia-Na Wei, Chi-Ting Liu, Hsi-Ting Hou

14. Effect of Neodymium Salti n the Anodization of Aluminum in Sulphuric Acid (N1337)
Xiaozhen Liu, Jumhua Yang, Aibing Yu, Gang Wang,L ingling Song,X iaoli Zhang

15. Preparation and Performance of Controlled-Release Tablets ofS asanquasaponin (N1532)
Xiaozhen Liu, Juhua Yang,Z hongfang Lai, Lingling Guo, Lingling Song, Yingzhen Shi

16. The Effect of Thai Compost on Biodegradability of Polylactic Acid Based on ISO 14855-2 Method (N3035)
Prakit Sukyai

17. Nano-Sized Silica Reinforcement of Epoxidized Natural Rubber Prepared in Latex State (N2321)
Methakarn Jarnthong,C haroen Nakason, Zheng Peng,N atinee Lopattananon

18. Synthesis of Alumina-Tungsten Carbide Composites by Self-Propagating High Temperature Synthesis Process (N2792)
Sutham Niyomwas

19. Wavelet-Based Denoising of Vibration Signals for Tool-Edge Wear Detection in High Speed Machining of Inconel 718 (N1490)
Ning Fang, P. Srinivasa Pai, Nathan Edwards

20. Al Ion Implantation of SiC Coated Carbon Fiber-Reinforced SiC Matrix Composites by Metal Vapor Vacuum Arc Ion Source (N2560)
Guojia Ma, Guoqiang Lin,H ongchen Wu

21. The Nanocrystallinity Enhancement of Sol-Gel Derived TiO2 Nanoparticles by Pre-Hydrothermal Treatment (N2363)
Akhmad Herman Yuwono, Yu Zhang, John Wang

Morning, December 18, 2011

08:30 AM—11:50 AM

Session B: Materials Processing Technology

3/F The First Meeting Room (大正 1 号会议室)

Chairmen: Prof. Chun-Huy Wang, Nan-Jeon Institute of Technology, Taiwan

Prof. Yunze Long, Qingdao University, China

(12 minutes for each presentation, including 2-3 minutes of answering questions)

1. Fabrication and Characterization of Regenerated Cellulose /TiO2 Nanocomposite Hybrid Fibers (N3236)
   Chaorong Li,S hunxin Shu

2. Synthesis. Electrical and Humidity Sensing Properties of BaTiO3 Nanofibers via Electrospinning (N3545)
   Hongdi Zhang, Yunze Long, Zhaojian Li,B in Sun, Chenhao Sheng

3. Influence of Thermal Behavior of Spindle on Machining Accuracy in Micro-Endmilling (N3712)
   Osamu Horiuchi, Mitsuyoshi Nomura, Boxiao Ma, Takayuki Shibata, Yoshihiko Murakami, Masami Masuda

4. Growth of Cu2ZnSnS4 Thin Films by Sulfurization of Co-Sputtered Metallic Precursors (N3276)
   Xinyi Li,D acheng Wang, Qinyang Du, Weifeng Liu, Guoshun Jiang, Changfei Zhu

5. Developmento f Tooling CostM odel for High Speed Hard Turning (N1296)
   Erry Yulian Triblas Adesta, Muataz Al Hazza, Delvis Agusman,A gus Geter E. Sutjipto

6. Self-Assembly of Large Scale and High-Quality Colloidal Particle Films by Spin-Coating (N3630)
   Zhaoting Yang, Qing Xu, Chaorong Li

7. Dislocation Generated by Electron Irradiation (N3266)
   Suryanto

8. The Research of CAD System in Three-Plate Parallel Indexing Cam Mechanism (N3769)
   Feng Xu, Yanhui He, Wei He,H ongtai Li

9. Synthesis of Phenothiazine Derivatives Containing Hetero Atom and Analysis of Conductive Polymer (N3234)
   Dae-Hee Yun, Han-Sol Yoo, Yong-Sung Park, Je-Wan Woo

10. Effect of Voltage Pattern on Intensity of Electromagnetic Emission during Electric Flame-Off Process of Ball Bonding Machine (N3468)
    Sarunya Puapairoj,C hiranut Sa-ngiamsak

11. Primary Study on Electron Beam Surfi-Sculpt of Ti-6Al-4V (N3113)
Xichang Wang, Shuili Gong,E nming Guo, Haiyan Zhao, Hengdong Xu

12. Design, Development & Experimental Investigation of Electro-Discharge Diamond Surface Grinding of Ti-6Al-4V (N2787)
Manoj Modi, Gopal Agarwal

13. Process Optimization and Properties of Laser Cladding High Speed Steel Coatings on Nodular Cast Iron (N1580)
Jianbin Lv, Zhengyi Wang, Changsheng Liu

14. Effect of Bi2O3 Addition on the Physical and Electrical Properties of Lead-Free (Na0.5Bi0.5)TiO3-Ba(Sn0.08Ti0.92)O3 Ceramics (N3094)
Chun-Huy Wang

15. Improved Properties of CENR/PP Blends by Using Compatibilizers for Promoting the Interfacial Adhesion between Phases (N2195)
Anoma Thitithammawong, Adam Kaewsare, Charoen Nakason

16. A Comparative Study of the Effect of Crosslink Agents and Chemical Modification on Properties of Natural Rubber Vulcanizates (N2345)
Anoma Thitithammawong, Rusmawatee Kasoe,C haroen Nakason

17. Thermal Characterization of Polyurethane from Castor Oil Reinforced Sugarcane Straw Composites (N2564)
Patrícia Câmara Miléo, George Jackson de Moraes Rocha, Adilson Roberto Gonçalves

18. Effect of Microstructure on the Corrosion Behavior of TiN Coatings (N2519)
Marwan Azzi, Jolanta-Eva Klemberg-Sapieha

19. A Research on Static and Dynamic Fracture-Resistance of Welding Parts of CoolantP iping Material (N2334)
Haochuang Li, Kwang-Hyeon Lee, Jea-Mean Koo, Chang-Sung Seok

20. Numerical Simulation of Fiber orientationo f Short Fiber ReinforcedP olypropylene in Injection Molding
Hesheng Liu,A ihua Xiong, Xingyuan Huang, Jiamei Lai

Morning, December 18, 2011

08:30 AM—11:50 AM

Session C: Advanced Manufacturing Technology

2/F The Third Meeting Room (大正 3 号会议室)

Chairmen: Prof. Chien-Jong Shih, Tamkang University, Taiwan

Prof. Zhengzhou Wang, Tongji University, China

(12 minutes for each presentation, including 2-3 minutes of answering questions)

1. Tool Wear in Sheet Metal Stamping(N2000)
   Wenyi Yan,M ichael P. Pereira, Bernard F. Rolfe

2. Finite Capacity Scheduling - Large System Design (N3230)
   Rodney L. Martin

3. Nozzle Flow Model of High Pressure Variable-Rate Spraying Based on PWM Technology (N2651)
   Changyuan Zhai, Xiu Wang,D ayin Liu, Wei Ma, Yijin Mao, Yongbing Ma

4. Numerical Simulation Analysis on the Ten Cross Rolls Straightening Process of the Heavy Calibre Seamless Steel Tube (N2301)
   Huagui Huang, Huanping Zheng, Fengshan Du, Wenzhang Wang

5. ZM Solid Catalysts for Synthesis of1 -Butoxy-2-Propanol with High Selectivity (N3004)
   Patuan Alfon, Johny W Soedarsono,D edi Priadi, Sulistijono

6. The Effects of Compression Pressure Applied on the Manufacture of Carbon Composite Bipolar Plate for PEMFC by Utilizing Graphite Waste Products (N2155)
   Yunita Sadeli, Johny W.S, Bambang Prihandoko,S ri Harjanto

7. Transformation of System Action for Reconfigurable Automation Work System (N2446)
   Muhamad Arfauz A Rahman,J ohn P. T.M o

8. Flame Retardation of PP/EPDM Composites Containing Ammonium Polyphosphate and Its Microcapsule (N3146)
   Zhengzhou Wang, Zhongqian Gu, Pingkai Jiang

9. Coating of Ti64 Bearings in Air by Using a Q-Sw Laser (N3729)
Justyna Rozwadowska, Katsuyuki Kida, Edson Costa Santos, Takashi Honda, Hitonobu Koike, Kenji Kanemasu

10. Investigation of Crack Initiation and Propagation during Rolling Contact Fatigue of SUJ2 Steel Bearings Using a Newly Developed one-Point Testing Machine (N3731)
Justyna Rozwadowska, Katsuyuki Kida, Edson Costa Santos, Takashi Honda, Hitonobu Koike, Yuji Kashima, Ryo Matsumoto

11. Inhomogeneous 3D Finite Element Model for Prediction of Free Surface Roughening (N2436)
Tsuyoshi Furushima, Tetsuro Masuda, Ken-ichi Manabe,S ergei Alexandrov

12. Deformation and Heat Transfer Analysis for High Speed Dieless Drawing of AZ31 Magnesium Alloy Tubes (N2434)
Tsuyoshi Furushima, Takuma Ikeda, Ken-ichi Manabe

13. An Intake Three-Pipeline Model Using Experimental Optimization for a Small Engine (N2629)
Chien-Jong Shih, Ting-Hao Chang, Tso-Liang Teng

14. Low Cost Diffuser Based Micropump Using Pinch Actuation (N2496)
Pei Song Chee, Ruzairi Abdul Rahim, U.Hashim, Rashidah Arsat, Pei Ling Leow

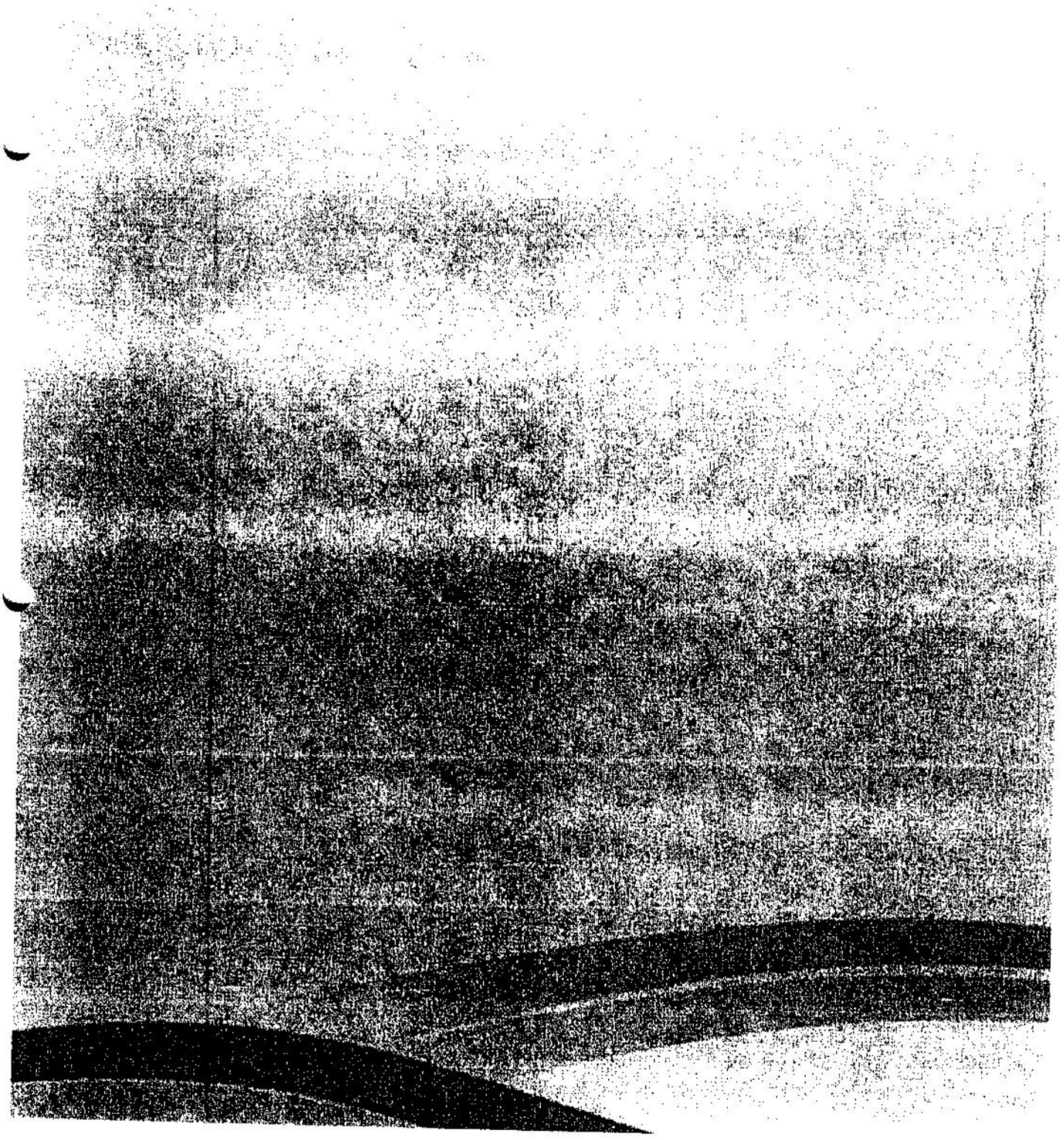
15. Evaluation of Welding Residual Stress Based on Temper Bead Welding Technique (N1630)
XianShi,Y iliang Zhang, Jianping Zhao, Ruibin Gou

16. Conductivity Studies on Li1-XAlxTi2-X(PO4)3 (X=0.0-0.5) Due to the Addition of Al3+ Trivalent Cation (N2907)
Maziidah Hamidi, Syafawati Nadiah Mohamed,M uhd Zu Azhan Yahya

17. Synthesis of Norbornene Derivative Using Diels-Alder Reaction (N3229)
JunSeong Park,H yun-Chul Oh, Yong Sung Park, Je-Wan Woo

18. Magnetic Abrasive Finishing - A Review (N1985)
M.G.Patil, K.Chandra, P.S.Misra

19. The Production of poly(L-Lactic acid) from 2-steps direct polycondensation in 100 kg scale (N3643)
Sommai Pivsa-Art, Weraporn Pivsa-Art, Sumonman Niamlang,K iyoaki Ishimoto, Hitomi Ohara



2011 International Conference on Advances in Materials and Manufacturing Processes

December 16-18, Guilin, China

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Manuscript Number	N3643
Authors	Sommai Pivsa-Art, Weraporn Pivsa-Art, Sumonman Niamlang*, Kiyoaki Ishimoto and Hitomi Ohara
Title	The Production of poly(L-Lactic acid) from 2-steps direct polycondensation in 100 kg scale

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2011-10-13

Production of Poly(L-lactic acid) from 2-Steps Direct Polycondensation in a 100 kg Scale

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Keywords: Poly(L-lactic acid), mass scale production, 2-steps direct polycondensation, solid state polymerization

Abstract. Synthesis of poly(L-lactic acid), PLLA, in a mass scale production using 2-steps direct polycondensation methods was investigated. One hundred kilogram of L-lactic acid was esterified in a designed reactor under reduced pressure at elevated temperature in the first step, followed solid state polymerization, SSP. The synthesized PLLA from both laboratory (5 g) and mass (100 L) scales show comparable melting temperature, T_m (151 – 172 °C) and molecular weight (Mn) (10,000 -32,000) at the similar polymerization conditions. The appearances of synthesized PLLA are yellow-white solid powder. The results show high potential to produce environmental friendly polymer, PLLA, using non-complex facilities process.

Introduction

Recently, many countries and states are banning petroleum based plastic grocery bags due to its non-degradable in environment, so biodegradable polymer has attracted much attention as the biodegradable plastic bag for the replacement of petroleum based plastic bag. Polyesters such as polyhydroxyalkanoates (PHA), polyhydroxybutyrates (PHB) and polylactic acid (PLA) play a predominant role as biodegradable plastics due to their potentially hydrolysable ester bond (Nampoothiri *et al*, 2010). Poly(L-lactic acid) PLLA is widely used to produces the biodegradable plastic bag, since the raw materials can be produced on a mass scale by the microbial fermentation of agricultural by products mainly the carbohydrate rich substances. PLA have the outstanding mechanical properties over other biodegradable polyester and in absence of enzymes or catalyst, PLLA degrade to lactic acid by simple hydrolysis [1]. In commercial production of PLLA is performed by using the ring opening polymerization (ROP) of the dimmer of L-lactic acid, L-lactide. The synthesized PLLA from ring opening polymerization of lactide, a process that uses catalysts such as tin, zinc, aluminum and lead, initiators such as *n*-, *sec*- and *tert*-butyl lithium, and solvent such as diphenyl ether, toluene and chloroform. Many of these components are toxic or flammable. As a result, this process requires purification to remove the unwanted materials from the product, which requires complex facilities [2]. The alternative route to produced PLLA is the direct polycondensation of L-lactic acid or oligomer of PLLA. However the synthesis of high molecular weight PLLA by this method is considered to be difficult, because of instability of the lactic acid oligomer and the difficulty in removing the water produced in the polymerization, which can encourage the depolymerization [3-4]. Thus, PLLA synthesized with the organic solvent and via melt-solid polymerization have been investigated. The direct polycondensation polymerization has 3

steps of polymerization: dehydration, polycondensation and solid state polymerization [5]. However, the use of solvent increases the difficulty of process control and polymer purification. These reasons increase the process cost and limits the process to small scale production [6]. To solve these limitation, the utilization of binary catalyst system of stannous (II) chloride dehydrate/para-toluene sulphonic acid monohydrate ($SnCl_2$/TSA) was studied. The higher molecular weight of PLLA was produced [7]. To obtain reduce the production cost and time in large scale, the low number of steps in production line is required. Thus a 2-steps direct polycondensation is developed; Step1 dehydration and polycondensation, Step2 solid state polymerization [8]. This 2-steps direct polycondensation is the process that has the possibility to scale up to large scales of PLLA production (100 kg Batch) for responsive to the higher demand in PLLA.

In this present work, PLLA was synthesized via 2-steps direct polycondensation in lab and mass scale to determine the potential of produce PLLA via environmental friendly and non-complex facilities process. The thermal properties and ^{1}H-NMR of synthesized PLLA from both scales were investigated.

Experiment

Materials

L-lactic acid (Galactic) with a monomer concentration of 90% w/w was used as received. *p*-Toluenesulfonic acid, PTSA was used as catalyst and used as received. Chloroform was used as the eluent in gel permeation chromatography (GPC). The polystyrene standard for GPC calibration was supplied by Sigma Aldrich Chemical Co. (USA).

Synthesis of PLLA

PLLA were synthesized by 2 steps direct polycondensation polymerization to obtain the PLLA oligomer and further polymerization by solid state polymerization to obtain high molecular weight PLLA.

Lab scale (5 g batch)

Direct polycondensation polymerizations were conducted in 25 ml custom made test tube with a mechanical stirrer and condenser connected to an inline cold trap and a vacuum pump. Thermometer was used to measure the exterior oil temperatures of the test tube. The reactor pressure was measured and controlled by vacuum controller (VCN500, OKANO). The pressure in the reactor was lower incrementally using a vacuum pump (G-50DA, ULVAC-KIKO).

Five grams of L-LA and 0.5%w/w of PTSA were added to reactor (test tube), PLLA was synthesized by direct polycondensation (DP) through three operations: distillation, oligomerization and polymerization. The temperature and pressure during the polymerization were precisely controlled at 150 °C 30 torr for 4 hr. At the end of the reaction, the products were poured in the plastic tube and allowed to cool to room temperature. After solidification, the product was grinded and annealed at 100 °C for 2 hr. Annealed product was further solid state polymerized in the reactor to obtain high molecular weight PLLA as 3 following steps: step1 110 °C 10 torr 5 hr, step 2 130 °C 10 torr 5 hr and step 3 150 °C 10 torr 5 hr.

Mass scale (100 kg batch)

For study the potential to produce PLLA in mass scale from direct polycondensation polymerizations, the similar reaction condition of lab scale was selected to compare the thermal properties and molecular weight of synthesized PLLA on the effect of reactor size. The reaction was conducted in 100 kg reactor with a paddle and condenser connected to an inline cold trap and a vacuum pump. Thermocouple was used to measure the internal of reactor and exterior oil temperatures. The reactor pressure was measured and controlled by vacuum controller (VCN500,

OKANO). The pressure in the reactor was lower incrementally using a rotary vacuum pump (K7503, OSAKA VACUUM ltd.)

One hundred kilograms of L-LA and 0.5%w/w of PTSA were added to reactor, PLLA was synthesized by direct polycondensation (DP) through three operations: distillation, oligomerization and polymerization. The temperature and pressure during the polymerization were precisely controlled. Polymerization was done for 4 hr at 30 torr after reaching 150°C. At the end of the reaction, the products were discharged at 150 °C in stainless bats and allowed to cool to room temperature for 7 hr and were kept in dry ice. After solidification, the product was grinded and annealed at 90 °C for 2 hr. Annealed product was further solid state polymerized in the reactor to obtain high molecular weight PLLA. The reaction temperature has to lower than melting temperature, T_m of sample to prevent the molten of PLLA [8-10]. Thus, the temperature was gradually increase step by step as following steps: step1 100 °C 10 torr 23 hr; step 2 115 °C 10 torr 8 hr; step 3 120 °C 10 torr 14 hr. and step 4 135 °C 10 torr 6 hr.

Analytical method

The PLA's weight average molecular weight (MW), number average molecular weight (Mn) and Mw/Mn ratio were determined using a gel permeation chromatography (GPC) system equipped with two chromatography columns and a RI detector. Chloroform was used as the eluent at a flow rate of 1 mL/min, and the molecular weight were calibrated to a polystyrene standard at 40 °C. The thermal properties (melting temperature, T_m and glass transition temperature, T_g) were measured by using DSC at heating rate 20 °C/min under N_2 atmosphere.

To confirm the successful of synthesized PLLA, ^{1}H-NMR was use to investigate the chemical structure of L-LA and PLLA.

Results and discussion

Thermal and physical properties of synthesized PLLA

The PLLA oligomer, that obtained from direct polycondensation were annealed and further polymerized by solid state polymerization, SSP, respectively, as previously described. In SSP, the polymerization temperatures have to lower than melting temperature, T_m to maintain the reaction in solid phase. Thus the reactions were stopped to sampling the synthesized PLLA for determining T_m by DSC before further polymerization. The physical and thermal properties of synthesized PLLA from both lab scale and mass scale are tabulated in Table 1 and 2, respectively. For both scale, thermal and physical properties show the similar results. After direct polycondensation, the low molecular weight PLLA or PLLA oligomer are obtained. Then synthesized PLLA oligomers were further polymerized via SSP at temperature below T_m. As longer solid state polymerization time, higher MW of PLLA is obtained due to the longer time and higher probability of oligomer to interact each other [8-9]. Melting temperatures, Tm also show the similar results, Tm of synthesized PLLA gradually increase with increasing SSP time as shown in Figure 1 and 2 for lab scale and mass scale, respectively. For lab scale, Tm of polymerized PLLA are 137, 140, 150, 162 and 172 °C for direct polycondensation, annealing, SSP step1, SSP step 2 and SSP step 3, respectively. For mass scale, Tm of polymerized PLLA are 130, 131, 130, 143, 150, 150 and 157 °C for direct polycondensation, annealing, SSP step1, SSP step 2, SSP step 3 and SSP step 4, respectively. As longer SSP time, higher and shaper DSC thermograms are obtained due to the increasing of reaction time [11-13]. The Tm and MW values of the synthesized PLLA from lab scale and mass scale are comparable at the same conditions. Thus the size of reactor does not show the effect on the Tm and MW of synthesized PPLA. For the physical characteristic also show the similar characteristic which are yellow-white solid power.

For mass scale, there are comments involved bumping of lactic acid during direct polycondensation and the agglomerations of molten PLLA during SSP due to low molecular weight of PLLA oligomer. To avoid bumping of lactic acid during direct polycondensation, gradually adjust

temperature and pressure are required. For preventing the agglomeration of PLLA in SSP, pre-anealling reaction at 40-50 °C is needed.

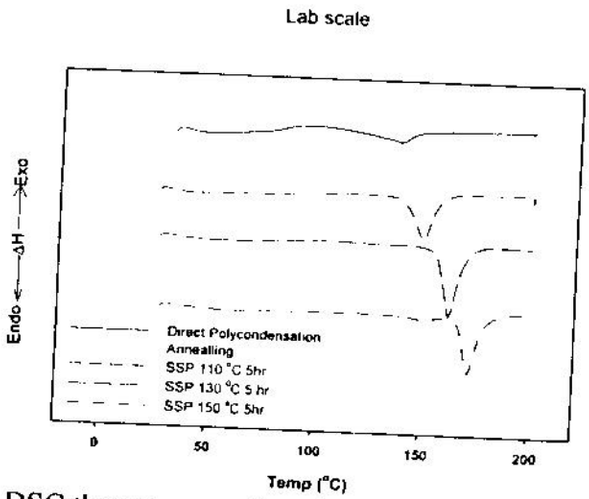


Figure 1. DSC thermogram of synthesized PLLA from mass scale.

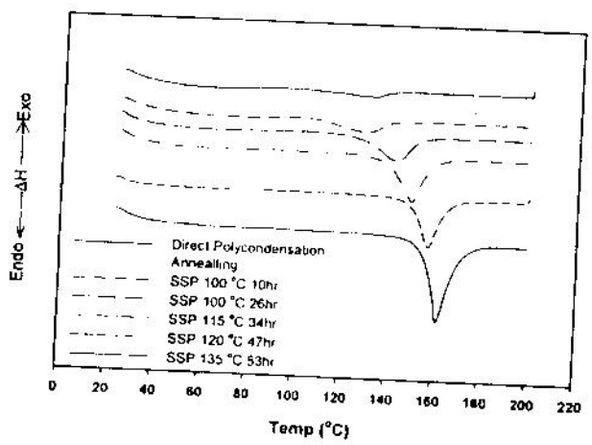


Figure 2. DSC thermogram of synthesized PLLA from mass scale.

Table1 Thermal and physical properties of synthesized of PLLA from lab scale (5 g)

Step	Condition	Yield (%)	Tc (°C)	Tm (°C)	MW	PDI	Characteristics	
							Appearance	Color
Melt Polymerization	150 °C 30 torr	62.75	96	137	3730	2.37	Solid-powder	White
Annealing	100 °C 1 atm		56	140	4220	2.08	Solid-powder	White
Solid state Polymerization/ 5h	110°C 10 torr 5 hr			150	7160	2.44	Solid-powder	White
Solid state Polymerization/ 10h	130°C 10 torr 5 hr			162	21300	2.17	Solid-powder	White
Solid state Polymerization/ 15h	150°C 10 torr 5 hr			151, 172	32400	2.19	Solid-powder	Yellow - white

Table2 Thermal and physical properties of synthesized of PLLA from mass scale

Step	Condition	Yield (%)	Tc (oC)	Tm (oC)	MW	PDI	Characteristics	
							Appearance	color
Melt Polymerization	150 °C 30 torr	75.25	92	130	3160	2.41	Solid-powder	White
Annealing	90 °C Atm 3 hr			131	3570	1.93	Solid-powder	White
Solid state Polymerization/ 10 hr	110°C 10 torr 7 hr			130	3790	1.89	Solid-powder *	Yellow -brown
Solid state Polymerization/ 26 hr	100°C 10 torr 16 hr			143	7050	2.14	Solid-powder, rock of melt part	Yellow -white
Solid state Polymerization/ 34 hr	115°C 10 torr 8 hr			150	10800	2.14	Solid-powder, Small rock	Yellow - white
Solid state Polymerization/ 47 hr	120°C 10 torr 13 hr			150	20200	2.36	Solid-powder, Small rock	Yellow - white
Solid state Polymerization/ 53 hr	135°C 10 torr 6 hr			157	24000	2.16	Solid-powder, Small rock	Yellow - white

* Partially melt

^{1}H- NMR characterizations

To confirm the successful of synthesize of PLLA, ^{1}H-NMR of lactic acid, PLLA oligomer and synthesized PLLA were investigated. For lab scale, the synthesized PLLA from lab scale was successfully synthesized as shown in Figure 3. Peaks at 5.1-5.3 ppm are the methane protons in LA repeat units, while the signals of methine protons in the end groups of the polymers appear at 4.4 ppm. The peaks at 1.6 ppm represent to methyl protons, which often interfere with those of residual lactic acid monomer [14-15].

For mass scale, PLLA were also successfully synthesized and confirmed by using ^{1}H-NMR as shown in Figure 4. After direct polycondensation reaction, synthesized PLLA oligomer shows two equilibria of L-lactic acid - PLLA (K1) and PLLA – lactide (K2) at the same time [16] as shown in Figure 5.

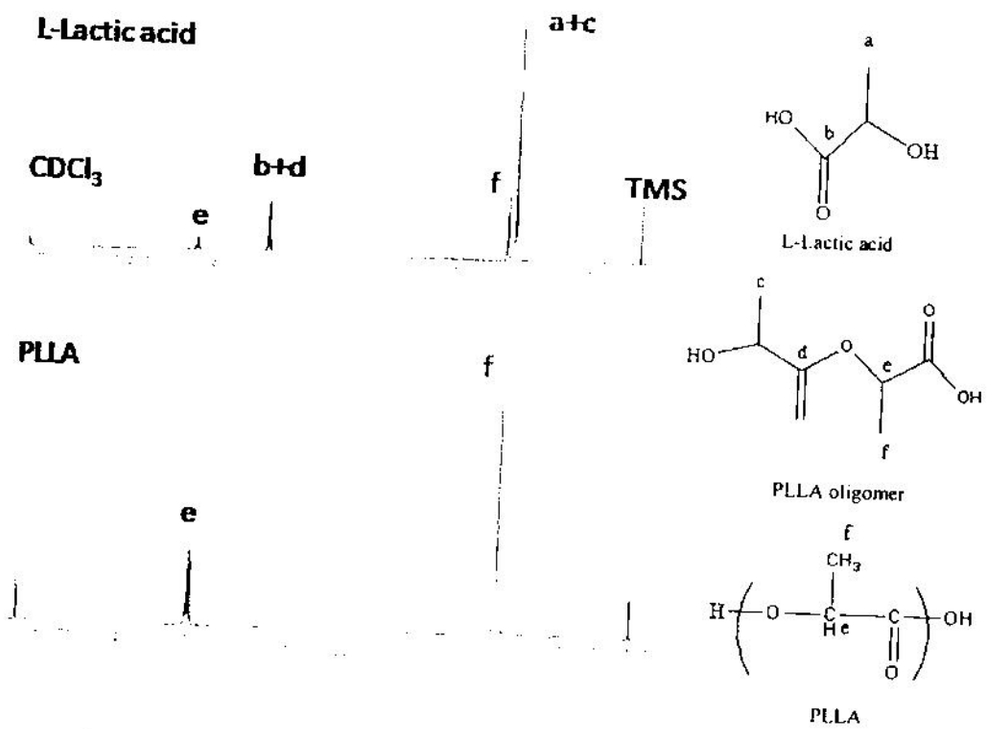
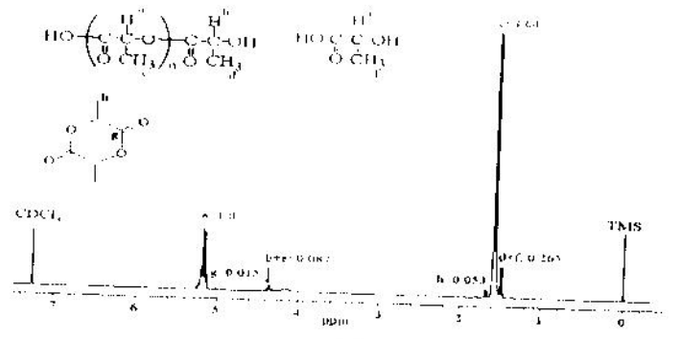
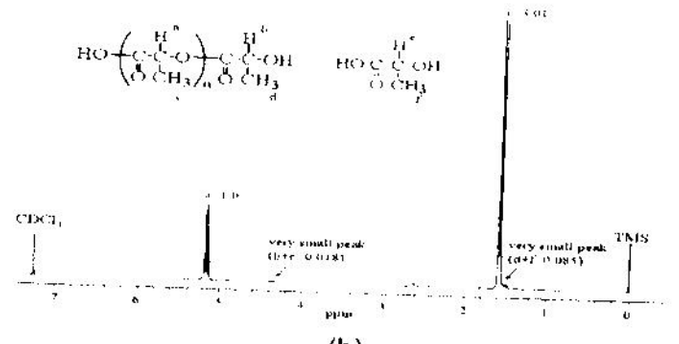


Figure 3. ^{1}H-NMR of synthesized PLLA from lab scale.



(a)



(b)

Figure 4. ^{13}H NMR of a) PLLA oligomer and b) synthesized PPLA from mass scale.

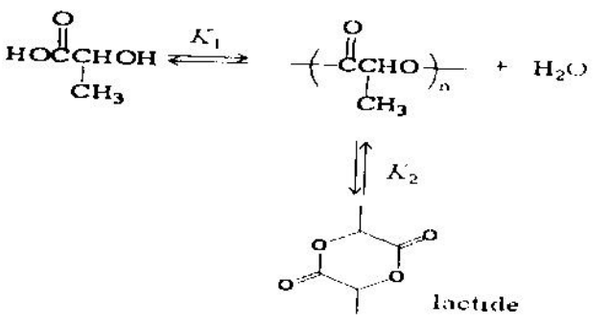


Figure 5. Schematic diagram of 2 reaction equilibria involved in direct polycondensation reaction.

Conclusions

To develop the environmental friendly and non-complex facilities process of PLLA production. In this work, PLLA was successfully synthesized via direct polycondensation and solid state polymerization in lab and mass scale and confirmed by using ^{1}H-NMR. The synthesized PLLA from both lab and mass scale shows the comparable melting temperature, T_m and MW. Thus there are high potential to produce PLLA from new process. The investigations of effect of time and reaction condition for high efficiency and economized reaction are required in future works.

Acknowledgements

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