

NEWSLETTER

www.eng.nus.edu.sg/m3tc

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Message from The Project Manager

Joining M3TC as a Research Fellow during its initial start-up in 2007, and taking on the role of Program Manager earlier this year, I have had the opportunity to be a part of and play an active role in the Centre's growth and development over the past four years. As a Centre focused on industrially relevant research, it is essential for us to interact and work closely with industry and be prepared to adapt and mold our research programs towards their technological needs. To assist in this mission, M3TC has a steering committee that includes members from the Economic Development Board, who have provided great support and guidance, as well as high-level industry professionals. Being located within the Faculty of Engineering at the National University of Singapore, we also have a pool of over 300 full-time faculty members from which to draw a wide range of expertise to form multi-disciplinary research teams in support of the Centre.



As the research scope set out for M3TC, particularly on minerals and mining-related activities, was quite new for Singapore, early activities primarily focused on capability development – taking and applying existing fundamental expertise within the Faculty. As can be seen from the lists of completed and ongoing R&D projects on our website (www.m3tc.sg), there has been a key shift in target research areas from metals and materials to minerals (coal in particular) and mining – largely influenced by changing economic factors and resulting regional and global industry needs and interests in these areas. M3TC can provide advisory services and R&D support to companies interested to work with us.

In addition to research, M3TC also takes an active role in manpower training activities, having held over 30 events - including seminars, guest lectures, workshops and conferences - and attracting close to 1,000 attendees to date. Indeed our research staff is also trained in conducting industry-relevant R&D in areas of interest to the mining and mineral resources sector. Particularly well attended, drawing numbers of participants even from outside Singapore, were workshops pertaining to the coal industry – Planning and Design for Ground Control in Underground Coal Mines and Industrial Drying: Principles and Practice. The Centre plans to hold additional workshops on related themes, such as Mine Ventilation, in the coming year, where we expect to see a continued high interest and participation from industry.

As M3TC moves ahead, building on our achieved foundation, we hope to expand upon our current network of academic, research and industry partners to forge continuing fruitful and impactful R&D collaborations with industry and academia alike.

Dr Jeremy D Lease
NUS, Singapore

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M3TC updates

Following are the newly appointed Research staff for various projects at M3TC

Ms Tan Hwee Sien
Research Engineer

(Project: Use of Modeling and Simulation Tools for Development of an Efficient Mine Ventilation System – Control of Dust and Methane Related Hazards in Coal Mines)

Dr Saththasivam Jayaprakash
Research Fellow

(Project: High-grade Activated Carbon from Low Rank Coal)

Mr Raghu Betha
Research Engineer

(Project: Development of New Hydrothermal Technology for Producing Biochar for Direct Co-combustion with Coal)

Abhinav Jain
Research Engineer

(Project: Understanding, Testing and Enhancing Mineralized Nanofluid Stability)

Conferences attended

Prof Seeram Ramakrishna delivered three plenary lectures as follows

Plenary Lecture on Engineering Nanofibers for Enhanced Biological, Chemical and Electronic Properties, International Conference on Nanoscience and Technology (ICONSAT-2012), Hyderabad, India, 20 – 23 January.

Plenary Lecture, 3rd G-COE International Symposium Zero Carbon Energy 2011, Electrospun Metal Oxides for Energy Applications, Suwon, South Korea, 18-19 August 2011

Plenary Lecture on Nanofibres and Global Challenges, iNANO annual meeting, Aarhus University, Denmark, 18 – 19 January 2011

Awards/Achievements

At the 7th Asia-Pacific Drying Conference held in Tianjin in September 2011, the global scale contributions made by M3TC were recognized with award of a Certificate which is reproduced below. Aside from R&D contributions via extensive archival publications the role of M3TC in promoting and disseminating R&D results was recognized via this special award.



Conference photos



Dr. Sachin Jangam and Dr. Agus Pulung Sasmito delivered invited lectures during The Mine Managers Show, Asia 2011 held at Conrad Bali, Indonesia during Dec 7- 8, 2011. The meeting was attended by mine managers for various parts of Asia. Dr. Jangam and Dr. Sasmito presented an overview of current R&D activities of M3TC, our vision and mission and our interest in industry collaboration in mining R&D

Professor Bala attended following two major conferences

“Bioleaching of Precious Metals from Mineral Ores: Current Challenges and Future Prospects (Keynote Lecture)”, International Conference on Copper Metallurgy, 26-28 October, 2011, Krakow, Poland.

“Energy Generation from Biomass Waste: Current Status and Future Prospects (Plenary Lecture)”, International Conference on Ecotoxicology and Environmental Sciences, November 28-30, Goa, India.

Completed Projects

Capturing of Carbon Dioxide in Liquid Magnesium for Developing Enhanced Performance Materials

Given the scenario that Mg-based alloy systems are quickly replacing other light-metals such as aluminum in the automotive and aerospace sectors, it would be of considerable industrial value to evaluate the phenomenon of CO₂ utilization during Mg-processing. The main objective of the project is to investigate the feasibility of carbon dioxide capture in Mg-Al alloys during primary processing.

The disintegrated melt deposition (DMD) technique was employed to process the monolithic Mg and Mg-Al alloys. When the Mg-Al alloys (with 3,5,7 and 9 wt% Al) and the commercially available AZ31 alloy with metallic Cr (Mg-3Al-1Zn + 5Cr) were incorporated with CO₂, investigations revealed that CO₂ did not affect the density, dimensional stability and grain morphology of the alloys. On the contrary, the interaction of carbon with the melt facilitated the formation of carbide phases, Fig. 1 (viz., Al₄C₃ and Cr₂₃C₆). The in situ formation of the carbide phase during processing significantly improved the mechanical properties when compared with those Mg-alloys processed without CO₂.

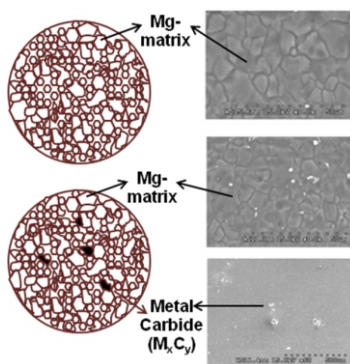


Fig. 1. Formation of M_xC_y due to the incorporation of CO₂ into Mg-alloy melt during processing.

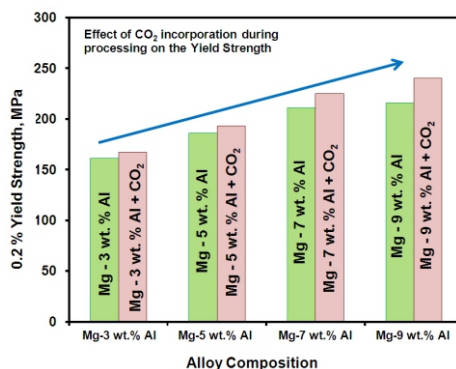


Fig. 2. Improvement in yield strength obtained due to CO₂ incorporation in Mg-Al melts.

From this investigation, it was identified that the amount of aluminium (Al) added played an important role in the formation of carbides and hence on the properties. It was clearly identified that in alloys with insufficient amount of aluminium to form aluminium carbide phase (i.e with ≤ 3 wt.%, such as in Mg-3Al and AZ31), the presence of carbide forming elements (such as Cr) facilitated the formation of the respective carbide. Such in situ formation of strengthening phase significantly improved the mechanical properties (Fig. 2). The overall highlight of the investigation is that, when incorporated with CO₂, no deleterious effects were observed on the strength properties of the material. The incorporation of CO₂ in Mg-Al melts hence proves promising.

Contact: Prof. M. Gupta, Mechanical Engineering, NUS
Email: mpengm@nus.edu.sg

New appointment - Business development officer

Mr. Karthik Somsundaram is appointed as a business development officer at M3TC. He will officially assume his duty by January 15, 2012. His main job will be to develop contacts with industry, business and government agencies in Singapore and the region to bring in appropriate R&D projects to M3TC under supervision and guidance of Director R&D.

Upcoming workshops/seminars

Seminar on "Innovation's Holy Grail : Getting More from Less for More" by Dr. R. A. Mashelkar
December 19, 2011

http://www.eng.nus.edu.sg/m3tc/Seminar/19January2012_Seminar%20by%20Dr%20Meshelkar.pdf

Venue - Faculty of Engineering, National University of Singapore

M3TC workshop will be held in conjunction with the 5th Asian Particle Technology Symposium (APT2012)
July 02-05, 2012

Venue - Faculty of Engineering, National University of Singapore

Industry Contacts

Companhia Brasileira de Metalurgia e Mineracao (CBMM), Brazil

Meeting with CBMM regarding production of Niobium in Brazil

Meeting/discussion with several coal companies
Straits Asia Resources Limited, Singapore

PT. Thriveri, Indonesia
Geo Coal Limited

Contacts

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Prof. Rajasekhar Bala
Director (Research)
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M3TC Personnel

M3TC has a rich resource of highly qualified and internationally recognized professors from various departments of the Faculty of Engineering of NUS. Following is a list of our colleagues who are currently working on M3TC projects as well as those who have completed M3TC projects earlier. In fact we also have a Faculty Associate, Dr. Poh Hee Joo of the Institute of High Performance Computing (IHPC), who is contributing to our R&D effort. M3TC is very keen to enhance industry interaction in our projects. Readers from industry are encouraged to contact Associates from the list below whose expertise may be relevant to their technological needs. We welcome such contacts and collaborations.

| | | | |
|----------------------------|-------------------------------------|--|---|
| Prof Zeng Hua Chun | Chemical & Biomolecular Engineering | chezhc@nus.edu.sg | Metal/Mineral Nano-catalysts for Synthesis of Methanol from Coal |
| Prof Jerry Fuh, Ying Hsi | Mechanical Engineering | mpefuhyh@nus.edu.sg | Advanced Processing for Powder Metallurgy (P/M) – High Performance and Cost Effective Materials |
| Prof Lu Li | Mechanical Engineering | luli@nus.edu.sg | Advanced Processing for Powder Metallurgy (P/M) – High Performance and Cost Effective Materials |
| A/Prof Manoj Gupta | Mechanical Engineering | mpegm@nus.edu.sg | Development of Futuristic Tin-based Materials as New Generation Electronic Solders; Capturing of Carbon Dioxide in Liquid Magnesium for Developing Enhanced Performance Materials |
| Prof Arun S Mujumdar | Mechanical Engineering | mpeasm@nus.edu.sg | Mathematical Modeling of Important Technological Processing in Minerals, Metals and Materials Processing; Development of a Cost-Effective and Energy Efficient Technique for Drying Low Rank Coal (LRC); Use of Modeling and Simulation Tools for Development of an Efficient Mine Ventilation System – Control of Dust and Methane Related Hazards in Coal Mines |
| Prof Tay Tong Earn | Mechanical Engineering | mpetayte@nus.edu.sg | Development of Manufacturing Capabilities for High Quality Cost-Effective Structural Composites |
| Prof Quek Ser Tong | Civil & Environmental Engineering | ceeqst@nus.edu.sg | Impact and Morphing Properties of Smart Fibre Metal Laminate |
| Dr Kuang Sze Chiang, Kevin | Civil & Environmental Engineering | ceeksck@nus.edu.sg | Impact and Morphing Properties of Smart Fibre Metal Laminate |
| A/Prof Hu Jiangyong | Civil & Environmental Engineering | ceehu jy@nus.edu.sg | Removing Natural Organic Matters (NOM) by Integrated Coagulation-Membrane System with Natural Iron Sand |
| Prof Wang Chi-Hwa | Chemical & Biomolecular Engineering | chewch@nus.edu.sg | Coal Gasification for Clean Energy Research |
| Dr Eldin Lim Wee Chuan | Chemical & Biomolecular Engineering | chelwce@nus.edu.sg | Coal Gasification for Clean Energy Research; Computational Studies of an Integrated Fluidized Bed Mixer-Dryer System for Pre-Processing of Feedstock for Co-gasification Processes |
| Dr Karl Erik Birgersson | Chemical & Biomolecular Engineering | chebke@nus.edu.sg | ; Development of a Cost-Effective and Energy Efficient Technique for Drying Low Rank Coal (LRC); Mathematical Multi-scale Framework for Total Air-Conditioning in Mines |
| Prof Ng Kim Choon | Mechanical Engineering | mpengkc@nus.edu.sg | High-grade Activated Carbon from Low Rank Coal |
| A/Prof Rajasekhar | Civil & Environmental | ceerbala@nus.edu.sg | A Novel Approach for Recovery of Copper and Precious Metals |
| Dr. Poh Hee Joo | IHPC/ASTAR | pohhj@ihpc.a-star.edu.sg | CFD Modeling of Underground Ventilation |

Journal/Conference Publications

S. Jayalakshmi, K.C. Guan, J.V. Kuma and M. Gupta (2011). Feasibility study on utilizing carbon dioxide for the processing of Mg-Al alloys. *Journal of Materials Processing Technology*, 211(8): 1416-1422.

S.V. Jangam and A.S. Mujumdar. Heat pump assisted drying technology - Overview with focus on energy, environment and product quality. In *Modern Drying Technology Volume 4 - Energy Savings*, E. Tsotsas and A.S. Mujumdar (Eds.). Wiley-VCH (2012), Weinheim, Germany.

Subramanian Jayalakshmi, Khoo Chee Guan, Kuma Joshua and Gupta Manoj
Structural, Physical and Mechanical Properties of Mg-Al Alloys Processed under CO₂ Atmosphere, International Conference on Advancement of Materials & Technology II (ICAMN 2010), Kuala Lumpur, Malaysia, 29 Nov to 1 Dec, 2010.

J.C. Kurnia, E. Birgersson, and A.S. Mujumdar (2011). A phenomenological model for hydrogels with rigid skin formation. *International Journal of Applied Mechanics*. (Accepted for publication)

J.C. Kurnia, E. Birgersson, and A. S. Mujumdar (2011). A mathematical model for pH-sensitive hydrogels for autonomous microfluidic flow control. *Journal of Functional Biomaterials*, 2 (3): 195-212.