The Institute of Materials, Malaysia

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IMM NEWSLETTER

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THE PRESIDENT'S MESSAGE

Dato' Dr Ong Eng Long
(President IMM)

Dear Members and friends of IMM,

This is the first issue of IMM newsletter for the year 2009. I am glad to be given the opportunity to pen my thoughts on issues affecting the industry and our Institute.

Traditionally IMM has excelled itself in promoting the importance of creating knowledge workers in welding, corrosion, paints and coatings, meeting the needs of the industry as Malaysia moves forward as an industrial nation. IMM continues to organise certification courses which have been very popular among our stake-holders.

Our strong collaboration with the industry has allowed us to constantly review and revise our training programme. One particular sector which deserves special mention is the welding sector. Over the last two decades, the welding scenario in Malaysia, especially those catered for the oil and gas industry, has changed tremendously in tandem with the development of the technology.

At the Welding Dialogue held on 31st March 2009, I highlighted that there is a need for us to address issues such as: qualification of the welding equipment, machine operator training and qualification, welding procedure specifications welding Inspector competency and welding Engineer requirements. I also mentioned that it was the intention of IMM to register and regulate the thousands of welders and other similarly skilled workers in the country through the Manpower Optimisation Scheme (MOS). The immediate benefits of MOS will be the availability of a harmonized skills management system, sharing of a common pool of skilled manpower, assurance of quality and skills standard, reducing the cost in welder qualifications, providing skills qualification and certification system and upgrading and maintaining the skill of welding operators. The MOS qualifies welders once and monitors the registration of these welders via Welder Qualification Tests "WQT", and standardizes Welding Procedure Specifications "WPS", thus reducing costs of re-qualification and yet maintaining the skills standards.

I am glad that the decision from the Welding Dialogue has overwhelmingly endorsed the proposal that IMM be the body responsible to qualify and certify welders for all industries in Malaysia. I am confident that Dr Ir Edwin Jong, who is the Chairman of the IMM Welding Committee will set his target to achieve this goal.

Another change in this newsletter is that we welcome contributions of research papers and review papers on materials and material technology. I am also hoping that the publication of IMM newsletter can be more frequent, say, to become a quarterly publication so that our members and friends can follow the activities of IMM and the recent development of the industry. I will need the support from all sectors to make this happening.

Thank you,
Dato Dr Ong Eng Long
(President IMM)

(Also see article on page 5)

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KIRK KENG CHUAN (MTE-Primos)

IMM INSTITUTE OF MATERIALS MALAYSIA

"To become the authority on materials science technology & engineering in Malaysia by 2020"

IMM Annual General Meeting

The Institute of Materials Malaysia (IMM) held the 19th Annual General Meeting on 31st March 2009. In his opening address, the president of IMM, Dato' Dr Ong Eng Long, expressed his hope for the materials community to grow continually. The IMM has more than two thousand four hundred in its membership roll presently.

Dato' Dr Ong also announced that IMM has become a member of the Asian Welding Federation (AWF). AWF has intended to adopt a standardized welder qualification programme among all the member countries. (Also see the President's Message on Page 1)

The meeting was preceded by a Welding Dialogue where several issues pertaining to the welding fraternity in Malaysia were discussed with Dr Edwin Jong presiding (see article on Page 5).

BIM Professional of the Year

"Currently (Maimunah) is the only Asian/ Malaysian lady engineer to be recognized as a Technical Authority for Shell Deepwater Engineering projects"

The Malaysian Professional Centre (Balai Ikhtisas Malaysia - BIM) organized the BIM-RI Integrity Night on 3 March 2009 at the Royal Lake Club in Kuala Lumpur. Outstanding professionals amongst its members, which included bodies from materials engineering, other engineering disciplines, architecture, entertainment and others, were honored for their professionalism and integrity in their respective fields.

Pn Hjh Maimunah Ismail - The IMM nominee for the BIM Professional Integrity Award

Pn Hjh Maimunah Ismail, was nominated by the Institute of Materials, Malaysia for the Professional Integrity Award, where there was fierce competition amongst the nominees.

Maimunah joined Sarawak Shell Exploration & Production company in March 1982 and spent 27 years in Corrosion Management (philosophies and practices), Materials selection and various Corrosion Control methods from design to operations. This included Technical Integrity Management and Quality Control in relation to verifying materials integrity in construction, operation and manufactured goods at the mills.

Her expertise in Asset Integrity reviews, Failure Analysis and Fitness for Service Assessments of ageing facilities and rectification requirements took her to various Shell operating companies from US to Europe and Asia. In Gabon, West Africa she was the Senior Materials, Corrosion & Inspection Engineer.

Upon her return from Gabon she was to take up the role of the Regional Leader and Technical Authority level 1 for EP Asia-Pacific covering Shell China, Philippines, Malaysia, Australia and New Zealand.

Currently, she is seconded to Shell Deepwater Engineering, at the Shell Houston branch office based in KL as the Principal Engineer in Materials, Corrosion, Inspection and Welding Engineering, making her the only Asian/Malaysian lady engineer to be recognized as a Technical Authority for Shell Deepwater Engineering projects.

IMM Working Committees 2008 - 2010

Examinations, Certification and Accreditation Panel (ECAP)
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Co-Secretary: Azman Murad
Committee Members:
Maimunah Ismail (Corrosion Comm)
Kang Kim Ang (Corrosion Comm)
Frankie Chua (Coatings Comm)
Yeoh Tian Hock (Coatings Comm)
Dr Edwin Jong (Welding Comm)
Hj Ghalib Tham (Welding Comm)

Coatings Committee
Co-Chairman: Johar Juhari
Co-chairman: Frankie Chua
Secretary: Yeoh Tian Hock
Committee Members:
Tan Ju Liang
Ting Lai Liong
David Lim
Kirk Keng Chuan (MTE)

Corrosion Committee
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Vice Chairman: Kang Kim Ang
Secretary: Mohd Rais Sabiyah
Committee Members:
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Junaidy Abdullah
Eric Lay
Huraizah Zainal-Nor
Dr Dzaraini B Kamarun
Rozie Sazlee
David Lim
Jeffery Ngau Uvang
Kirk Keng Chuan (MTE)

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Vice Chairman: Hj Ghalib Tham
Secretary: Md Hafidzuddin Mohd Salleh
Committee Members:
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Abu Bakar Mohd Arif
Lorganaden Varathan
Ismail Abu Bakar
Faisal Luis Amorsolo
Kirk Keng Chuan (MTE)

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Dr Cheong Kuan Yew
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Dr Mariatti Jaafar
Dr Azura And. Rashid
Dr Nurulakmal Mhd Sharif

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East Coast Region
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Secretary: Lai Kok Leong
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Liew Wei Yew
Sylvia Laggat
Priscilla Henry

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Vice Chairman: Leong Yin Chin
Secretary: Felix Bantin Ak Amit
Committee Members:
Chung Yih Yenn
Steward Siran

Kuching
Advisor: Andrew Ronggie
Chairman: Nuzul Adzwan Sulaiman
Committee Members:
Biran ak Atu
Dominic Christopher ak Keli

Labuan
Chairman: John Wong Pak Kung
Secretary: Chrys Johanathan
Treasurer: Ooi Ling Lew
Committee Members:
Jeffery Ngau
Rohaiza Morshaid
Liew Ep Ping
Bonaventure Petrus
Chieng Kung Lik
M Lokman B Mat Nor

CORROSION & WELDING SEMINAR IN MIRI

Some of the participants of the seminar in Miri

Miri, January 13, 2009 - The local IMM committee, headed by Mr Ong Hock Guan, organized the Corrosion and Welding Seminar, which was held at the Kelab Rekreasi Petroliam, Lutong.

The seminar was well attended and supported by many local professionals and representatives in the exuberant oil and gas industry. Topics covered included Hyberbaric Welding, Thermal Spray Coatings and Overlaid Cladding Welding of A333 Pipe With Incoloy 625

As Chairman of the IMM Committee in Miri, Ong expressed his appreciation for the learning and sharing during the seminar. He hoped that "more similar seminars be organized in the future for the benefit of the Materials fraternity in Miri".

Mr Ong Hock Guan, Chairman of IMM, Miri Committee

CORROSION SEMINAR—BINTULU

A section of the participants in Bintulu

Mr Yii Ming Sing, Chairman of IMM, Bintulu Committee

Bintulu, January 15, 2009 - The materials community in Bintulu benefitted much from the Corrosion Seminar, which was jointly organized by the Institute of Materials, Malaysia (IMM) and the Institution of Engineers (IEM), Bintulu Chapter. The IEM Bintulu Chairman, Ir Abdul Nasser b Abdul Wahad, (also the Senior Manager of Bintulu Port Container Terminal Division) hosted the event and lunch, welcomed the participants. Speakers included Mr Frankie Chua (Co-Chairman, Coatings Committee) and Mr Kang Kim Ang (Dep. Chairman, Corrosion Committee).

Mr Yii Ming Sing, chairman of IMM, Bintulu committee, expressed that "more of such events will be organised in the future."

WELDING TECHNOLOGY IN THE 21ST CENTURY

Welding Dialogue Panelists (L-R): Hj Ghalib Tham, Dr Abdul Aziz Mohd, Jeffrey Uvang & Md Hafidzuddin Mohd Salleh

Kuala Lumpur, March 31, 2009 - A dialogue themed "Welding Technology in the 21st Century" was held in conjunction with the 19th Annual General Meeting of the Institute of Materials, Malaysia.

Dr Ir Edwin Jong, the Chairman of the IMM Welding Committee, provided the prologue to the seminar. In his presentation, he touched on the different new technologies, including robotic welding.

A panel comprising professionals from the Welding fraternity then shared their views on "The acceptance of ISO standards or ASME Standards or other Standards for welding in Malaysia through the Asian Welding Federation (AWF) initiatives by all oil & gas operators in Malaysia as opposed to company standards", "The review of new advanced technologies to be adopted by the welding & inspection industry in Malaysia such as computerized automatic welding techniques, automatic NDT methods" and "The consideration for IMM to be the recognized certification body for welders in Malaysia ".

Dr Ir Edwin Jong, Chairman of IMM Welding Committee, addressing the audience

The above issues were discussed with active participation and feedback from the floor.

SKG-15 Specialist Engineers' Meeting & Symposium 2009

The Skill Group 15 (SKG-15) Specialist Engineers' Meeting and Symposium (SEMS) 2009, hosted by PETRONAS' Group Technology Solutions (GTS), Research & Technology Division (R&TD) and cosponsored by Group Technology Capability Management (GTCM), R&TD took place on 3-4 February at the Palace of Golden Horses, Serdang.

Officiated by Mr Pramod Kumar, Senior General Manager of GTS, the symposium was attended by a total of 208 participants and exhibitors, featuring 19 exhibition booths and 34 technical paper presentations.

Among those present were PETRONAS staff, local authorities and international oil and gas professionals.

SKG-15 Skillgroup Advisor and General Manager of MTBE, Tuan Hj Ahmad Kamal B M Salleh, in his welcoming speech emphasised the importance of knowledge sharing and networking towards realising our goal of becoming a global champion. He also exhorted the young engineers to make the most of the ACD programme to develop their capabilities at an accelerated pace.

Meanwhile, Mr Pramod Kumar stressed on the need to sustain the integrity of our aging equipment and facilities through our competencies and available technologies, especially in difficult times such as today. A strong believer in the Accelerated Capability Development (ACD) programme, he is proud that the ACD programme provides one of the most comprehensive training syllabi in the oil and gas industry. The brainchild of GTS, ACD is currently implemented group-wide under the umbrella of GTCM and a mandatory requirement for E1 and E2 executives. Also highlighted was the transformation journey of the Materials, Corrosion and Inspection unit to Asset Integrity Management under the Engineering Department.

On the technological front, Mr Pramod expressed confidence that GTS will continue to provide support to all OPUs through the PETRONAS-Risk Based Inspection, Fitness For Service, Corrosion Management Plan, and Non-Destruction Testing capabilities among others.

The two-day symposium covered a wide range of issues concerning the oil and gas industry from the upstream to downstream sectors.

Noteworthy were the discussions that touched on PETRONAS' current concerns such as the PL333 crude oil pipeline, the commissioning of Mega Methanol, our economic downturn and the need to optimize operating costs.

This biennial event, previously exclusive to SKG-15 members, now includes papers from other SKGs on their best practices and lessons learnt. Invited speakers from the Knowledge Management Unit and Group Technology Capability Management Department provided some valuable insight into the Capability Management and the Knowledge Management systems.

Tuan Hj Ahmad Kamal B M Salleh addressing the participants at the opening

The theme this year, "Enhancing Integrity, Nurturing World-Class Capability" placed much emphasis on the ACD programme, and also on realising the PETRONAS corporate agenda through the consolidation of the integrity of our assets.

Lauded as one of the most successful meetings, this year's symposium also charted a record turnout in the history of the SEMS. GTS would like to thank all parties involved for having contributed to the success of the Symposium.

Having raised the bar once again, we now look to the host of SEMS 2011, Universiti Teknologi PETRONAS, to surpass the legacy of excellence even as we aim for greater heights together.

IMM participated actively at SEMS 2009 as an exhibitor

"... need to sustain the integrity of aging equipment and facilities through competencies and available technologies"

CORROSION

By Maimunah Ismail

When subtle changes to bare metal hue
From dull grey steel turn rustic autumn bright
Or fiery copper red toned to turquoise blue
These are signs that *it* begins *its* plight

Slowly, silently *it* toils on unrelentlessly
Creeping on the surface or seeping internally
Completing the cycle of electrochemical activity
Through anode, cathode, and electrolyte as the entity

It will alter mighty structures in *its* search
Transforming architectures to hideous monuments
Decreasing reliability unlike the Midas touch
Spilling containments to damage environments

What transpires *it* to such behaviour indeed?
From humble stable metal ores these are estranged
Killed, alloyed and moulded to engineering needs
Finally made to possess monstrous strength

Through these steps of gigantic production
Energy states raised to stunning elevation
Rendering metals to unstable situation
Yearning to be released to their former condition

In order to maintain technical integrity
Man learned to control *its* unleashing of energy
Designed barrier and sacrificial in solidarity
Specialized alloys that won't succumb easily

Alas To err is man's natural trait
Not wanting to spend, reducing stance
Forgetting *it* has unwavering might
Thru weakened barricades finally *its* chance

Maimunah Ismail

(Pn Hjh Maimunah Ismail is the Chairman of the IMM Corrosion Committee 2008-2010)

MANPOWER OPTIMISATION SCHEME

PRIMOS

The Manpower Optimisation Scheme (MOS) introduced recently to oversee the continuous work experience of skilled tradesmen, has now in its register close to six hundred workmen. Those registered in MOS are automatically re-certified as long as their records are up to date and in order. The scheme is easily accessible to project owners, clients, fabricators and contractors who can seek qualified, experienced and skilled workers from the database via the internet. For more information, please call Primos at Tel: (603) 5882 3574 or email info@mte.com.my .

*" **It** (Corrosion) will alter mighty structures in **its** search, Transforming architectures to hideous monuments "*

4TH RAMM & 2ND ASMP 2009 IN PENANG

Prof. Dr. Ahmad Fauzi Mohd Noor addressing the delegates at the opening of RAMM/ASMP 09

The Institute of Materials, Malaysia (Northern Region), together with the School of Materials & Minerals Resources Engineering (Universiti Sains Malaysia), Japan Society of Mechanical Engineers, Advanced Materials Processing & Integrity Group UKM, Malaysian Chamber of Mines and the Institute of Engineers Malaysia jointly organised the 4th International Conference on Recent Advances in Materials, Minerals & Environment and 2nd Asian Symposium on Materials & Processing (RAMM & ASMP 09) held in Penang from 1-3 June 2009.

Based on the theme "Excellence in Materials, Minerals and Environmental Research for Sustainable Tomorrow", the conference attracted 189 oral and 180 poster presentations. More than 380 participants from several countries including Japan, with the largest number of delegates, USA, India, Singapore, Iran and Nigeria were present.

MATERIALS CONGRESS COMING TO KUALA LUMPUR

Participants at the M3C 2009. Front row (L-R) : Mr Trevor Lewis, Prof Ian Pashby, Dr Brett Suddell

The Institute of Materials, Minerals and Mining (IOM3) Malaysian Branch successfully organised a one-day conference M3C 2009 themed "The Role of Materials, Minerals and Mining Technologies for Sustainable Development" on 7th April 2009 at the Kuala Lumpur campus of the University of Nottingham in Kuala Lumpur. It attracted more than 80 participants and 10 oral papers. A technical visit to the Penjom Gold Mine the next day witnessed some very excited participants.

At the close of the conference, the institute held its Annual General Meeting, followed by a Networking Dinner.

The AGM elected the following to the IOM3 EXCO for the year 2009/2010:

Mr Yip Foo Weng - Chairman
Mr Max Ong Chong Hup - Hon Secretary
En Redzuan B. Mohd. Ramli - Immediate Past President

Committee Members

Dr Andrew Spowage -	1st year
Mr Choo Mun Keong -	1st year
Dr Leong Kok Hoong -	1st year
Datuk Fateh Chand -	2nd year
Dr Ng Wing Kong -	2nd year
Mr Lim Weng Tong -	2nd year

Dr Brett Suddell, Senior Vice President and Honorary Overseas Secretary of IOM3 UK, graced the AGM. He offered Malaysian students who are keen to join IOM3 a fantastic opportunity by waiving membership fee from this year on. In addition, IOM3 UK will review the current annual subscription fees charged to local members.

The high point of the meeting was when Dr Suddell announced "The Materials Congress will be held in Kuala Lumpur in September 2010". The Congress, which will be held outside the United Kingdom for the first time, will be organized in conjunction with the 50th Anniversary Celebration of IOM3 Malaysian Branch and the Young Persons' World Lecture Competition.

We congratulate the new team in the IOM3 EXCO, and the successful bid for the Materials Congress to be brought to Kuala Lumpur.

The Institute of Materials, Minerals and Mining, Malaysian Branch

Mr Yip Foo Weng, Chairman of IOM3 (Malaysian Branch), at the M3C

University Undergraduate, Masters & Postgraduate students

interested in the free student membership should submit their particulars to IOM3 UK Membership Administration Officer , Mrs. Ellie Handley at email: Ellie.Handley@iom3.org

IMM Expands into Sabah and Sarawak

The Institute of Materials, Malaysia (IMM) is going great guns in Sabah and Sarawak. The eastern states of Malaysia have two new committees added to the ever-growing stable of IMM.

In a recent visit to these states, members from Kuching and Labuan have agreed to form a committee where IMM can be promoted for the benefit of the materials fraternities in the communities in those cities. The objectives of IMM to promote the honourable practice and professional ethics and encourage education in materials science and engineering can be well served with the new committees set up.

Nuzul Adzwan Sulaiman of Brooke Dockyard, has agreed to head the committee in Kuching. An active member of OSFAM, he will be assisted by a committee to be indentified soon. The Advisor of the committee will be Andrew Ronggie (Head, Loss prevention Unit [QA/HSE], Brooke Dockyard). Other interested parties to be in the Kuching committee will include Wan Mohd Naguib b. Abdul Rahman and Gary AK John from the Polytekenik Kuching.

In Labuan, John Wong Pak Kung, Inspection Manager of Petronas Methanol (Labuan) Sdn Bhd readily accepted to be the Chairman of the committee there. At the inaugural dinner with more than 20 IMM members in attendance, John stressed the virtue of being active members of IMM and the benefits of the courses that MTE provides. He immediately announced the appointment of Chrys Johanathan as Secretary of IMM Labuan.

(L) John Wong stressing a point at the dinner for IMM members. (R) Andrew Ronggie striking a pose for the camera

The committees in Kuching and Labuan are ready to spearhead the work of IMM in their respective areas.

We wish the two new committees a very warm welcome and great success.

"The eastern states of Malaysia have two new committees added to the ever-growing stable of IMM"

Characterisation of Nanoprecipitation Mechanisms during Isochronal Ageing of a Pseudo binary Al-8.7Li at % Alloy

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Andrew.Spowage@Nottingham.edu.my

"The addition of Lithium to Aluminium alloys is known to afford the dual advantages of increasing mechanical performance while lowering density. These characteristics make Al-Li alloys particularly desirable for aerospace applications"

Abstract

The addition of Lithium to Aluminium alloys is known to afford the dual advantages of increasing mechanical performance while lowering density. These characteristics make Al-Li alloys particularly desirable for aerospace applications. However, the complex precipitation pathways and extensive nanometre sized decomposition products, termed "nanoprecipitates", makes characterisation difficult and thus limits optimisation of the property sets of commercial alloys. This investigation uses thermal analysis and electrical resistivity methods to further understanding of the evolution of the various nanoprecipitates during isochronal ageing of an Al-8.7 at% Li alloy. The results indicate decomposition via the following pathway: Spinodal-Ordering → Congruent Ordering + Spinodal Decomposition + Dissolution of Small Spinodally ordered regions → Growth of d` → Dissolution of d` → Nucleation & Growth followed by Dissolution of d phase.

Introduction

The nature of precipitates, their composition, size distribution, locations, and the nature of there interface with the matrix strongly influences the mechanical and physical properties of advanced alloys. In many Aluminium alloys clusters, ordered domains and other forms of "nanoprecipitation" make a significant contribution to the overall property sets of alloys. The small size of these nanoprecipitates makes investigation of their decomposition pathways difficult in commercial alloys as their physical effects are often masked by the effects of conventionally sized second phase precipitation. In the Al-Li system this issue is further compounded by the low lattice misfit, relatively low volume fraction, massive precipitation of the primary strengthening phase, d`, as well as a similar composition and structure to both the matrix and to d`. These factors make characterisation of the nanoprecipitate structure and thus an investigation of the decomposition mechanisms extremely challenging.

Several authors have carried out both theoretical and experimental investigations that aim to predict the decomposition of binary Al-Li alloys. The theoretical work of Khachaturyan et al noted a number of flaws in previous models and produced what is considered to be the leading thermodynamic sub-phase model, Figure 1. High resolution transmission electron microscopy work by Mijasato et al, Radmilovic et al and Sato et al supported much of the Khachaturyan findings. Schmitz et al also imaged ordered domains using HREM but argued that this did not constitute conclusive support for the decomposition pathways proposed. Several diffraction studies by Fujikawa et al, Sato & Kamio discovered evidence which also partially supported the models. Mahadev et al, using X-ray scattering, found no evidence for the congruent ordering or spinodal pathways predicted by the models in an 11.4at.%Li alloy and suggested that d' formed by a classical nucleation and growth. Further, Williams & Eddington noted that X-ray sidebands, which are normally associated with a spinodal reaction, were lacking from the available data on Al-Li alloys. However, it has since been pointed out by Yu & Chen that sideband prediction is based on the linear, harmonic theory of Cahn & Hilliard, and as such may not always be detected as the theory is only applicable at the early stages of decomposition which is difficult to characterise due to the rapid precipitation kinetics in the system.

The importance of these alloys combined with the uncertainties in the existing literature and the difficulties in obtaining reliable data by the techniques traditionally used to investigate nanoprecipitation phenomena i.e. TEM, X-ray and neutron diffraction are the drivers for the

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present work. In this work a combined study using isochronal resistivity and differential scanning calorimetry have been used to further understanding of the evolution of the

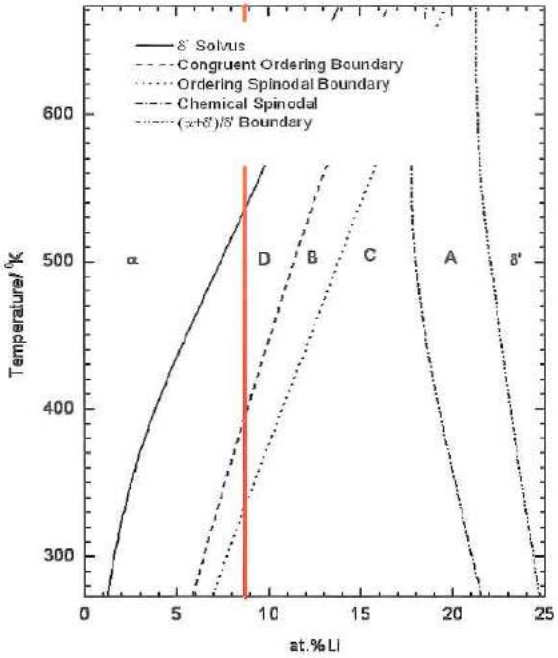

Figure 1: Khachaturyan et al sub-phase diagram[1]

nanoprecipitate structure in an Al-8.7 at% Li alloy. These techniques have the advantage that they can characterise the products of nanoprecipitation reactions on bulk samples thus allowing meaningful sample volumes to be investigated. In addition, both techniques allow the samples to be kept below room temperature during the early stages of ageing thus allowing interrogation of the early stages of decomposition.

Experimental Methodology

A pseudo binary Al-8.7Li-(0.07Zr) alloy, was prepared by induction melting, extrusion followed by hot rolling into 1.6mm think sheets. Standard four point resistivity specimens, as shown in Figure 2, were wire cut from the sheet, solution treated (823K for 15minutes) and quenched into iced brine (254K). Further details regarding the sample preparation procedure can be obtained from Noble & Bray.

Isochronal aging for the resistivity (ICR) experiments were carried out in a high temperature oil bath with a simulated heating rate of 20K / min (temperature control ± 2K). Resistivity measurements were recorded after placing the sample in liquid nitrogen using a Cuprico D500 high precision ohmmeter capable of measuring changes in resistivity down to the nano ohm range. Differential scanning calorimetry (DSC) samples were prepared by punching out 6mm diameter disks from the solution treated alloy sheets after which both surfaces were removed by grinding in a custom made chilled grinding block. DSC thermograms were obtained from a Perkin Elmer DSC 7 equipped with a liquid nitrogen chilled cooling block at a heating rate of 20K/min.

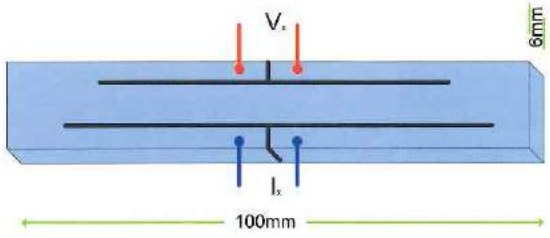

Figure 2: Four point probe resistivity samples

Results from Isochronal Resistivity Experiments

The high resolution 4-point resistivity measurements carried out after isochronal aging the Al-8.7Li pseudo binary alloy indicates various phase transformations occur during decomposition of the supersaturated solid solution (SSSS), Figure 3. Isochronal aging at the first two temperatures (273 & 293K), resulted in a decrease in resistivity, Figure 4. This early aging treatment (273-373K) was repeated several times on equivalent samples to confirm that it was a real observation, in each case an equivalent resistivity decrease was observed. Resistivity decreases are associated with either an increase in lattice order over length scales larger than the mean free path of the electrons or a decrease in lattice scattering associated with events such as lowering of the solute content of the matrix. As the temperature is relatively low it is unlikely that true precipitates will have had sufficient time to form and grow beyond a size which causes scattering. Thus the rapid reaction kinetics support the hypothesis that a ordering event occurs at low temperatures, such events require only local atom exchanges rather than the bulk diffusion needed to form an extensive network of large precipitates. Higher aging temperatures result in a small increase in resistivity up to a peak (380K) followed by a large decrease. At such low aging temperatures a resistivity increases during the decomposition of a SSSS are most typically associated with the formation of a large number of small scattering centres which shorten the mean free path

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of the conduction electrons. The subsequent decrease from the resistivity peak could either be associated with the growth of these small scattering centres beyond this size or the nucleation of new, small secondary precipitates and their rapid growth. The magnitude of the resistivity decrease is relatively large suggesting extensive removal of solute from the supersaturated lattice.

At isochronal ageing temperatures above 500K the resistivity increases indicates an increase in solute content of the matrix. Higher temperatures result in another decrease to a second valley followed by an increase to a value near the as quenched resistivity. At these relatively high temperatures this event is associated with the formation of an equilibrium phase which lowers the solute content as it forms and grows before it starts to dissolve at higher temperatures returning solute into solution and thus increasing lattice scattering. Higher temperatures resulted in a progressive decrease in resistivity which is most probably associated with the loss of lithium from the sample during high temperature aging. This together with a lower vacancy concentration compared to the as-quenched alloy are the most likely reasons why the resistivity does not return to the as- quenched value. This portion of the curve will not be considered further in this work.

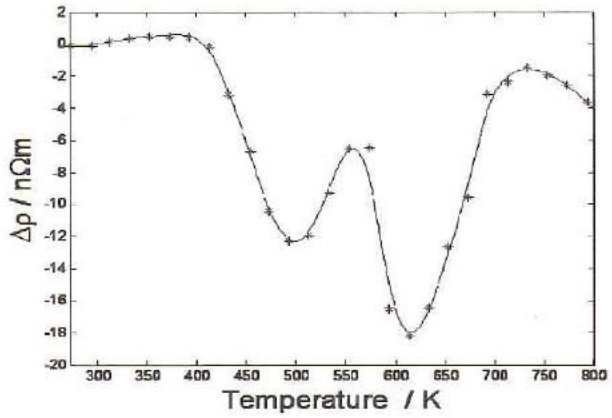

Figure 3: Change in resistivity during isochronal ageing

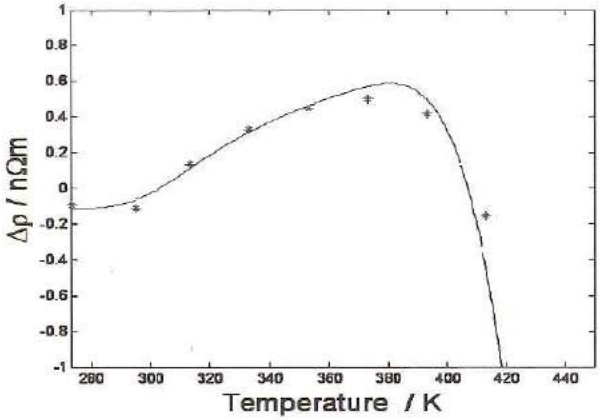

Figure 4: Change in resistivity during the early stages of isochronal ageing

Results from Isochronal Differential Scanning Calorimetry

The thermogram from the differential scanning calorimeter, obtained at an equivalent heating cycle as the resistivity experiment and also indicates a number of phase changes occur during isochronal ageing. Within the inevitable short, near room temperature, exposure during preparation of the DSC samples, it can be expected that the first event observed in the resistivity experiment, a resistivity decrease, Figure 4, has occurred before the DSC analysis. The first observation on the DSC thermogram is a low temperature endotherm characteristic of a dissolution event. As the dissolution temperature is low it is reasonable to assume that the phase dissolving is extremely small, i.e. dissolution of a nanoprecipitate. The second event is an exotherm characteristic of the formation of a

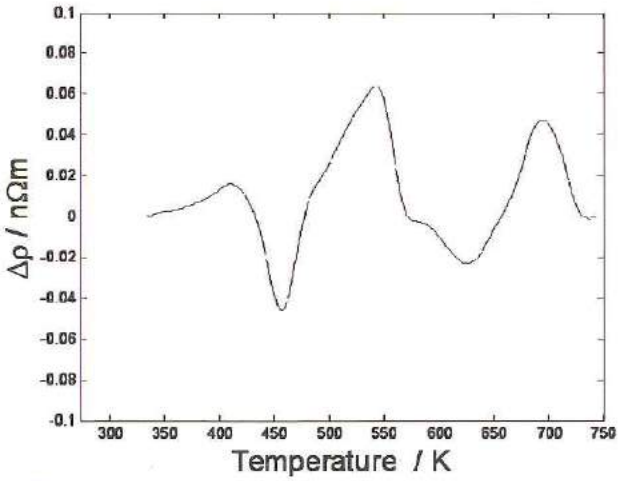

Figure 5 : Differential scanning calorimetry analysis

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true precipitate. As the scanning temperature increases, a second endotherm of a size comparable to the previous exotherm is observed. The similar size of peaks and the lack of other events suggests the formation and then dissolution of the same phase as temperature increases. At higher temperatures a second pair of exo - endotherms suggests the precipitation and dissolution of a high temperature phase.

Discussion

Noble and Bray[12] used similar solution treatment and quenching conditions to examine an Al-9.0Li-0.14Zr alloy in the as-quenched condition. They assumed the starting state of the alloy was a supersaturated solid solution with a high vacancy concentration and a partially ordered matrix containing discrete d`-nuclei. DSC analysis resulted in the detection of a small initial exotherm not detected in the thermograms discussed in this paper. Their analysis attributed this event to a continuation of the ordering process, which had begun during quenching. According to the phase diagram proposed by Khachaturyan et al this alloy would be in a thermodynamic sub-phase region expected to undergo continuous ordering of the matrix. This observation supports the association of the initial resistivity decrease observed in Figure 4 with a large scale increase in lattice order rather than a lowering of lattice solute concentration due to the formation of large precipitates. Therefore it appears that the alloy undergoes a spinodal-ordering reaction producing ordered domains throughout the entire lattice during the short room temperature exposure which occurs during DSC sample preparation and the initial ageing treatment during ICR. This spinodal-ordering explanation is supported by the high resolution transmission electron microscopy work of Radmilovic et al who in a similar alloy, (Al-2.4Li) found that ice brine quenching resulted in modulated order/disordered regions. This was taken as firm evidence for the occurrence of spinodal-ordering.

It follows that the first endotherm in Figure 5 is due to the dissolution of these spinodally ordered regions. Thermodynamically it will be the smallest of these ordered domains which dissolve first. Khachaturyan et al predicts that these domains may undergo spinodal decomposition to form true d`, an event not predicted to result in a net endothermic reaction. It is also apparent from the progressive increase in resistivity (rather than a step change) within this temperature region that this event does not occur spontaneously, thus it may be that the alloy has moved into region C of the sub-phase diagram (Figure 1) and new ordered domains are also being formed by a congruent ordering processes. The formation or formation then decomposition of congruently ordered domains could cause an increase in resistivity if there size was lower than the mean free path. However, such an event would not be expected to result in an endothermic peak in the DSC thermogram which suggests the dissolution of the spinodally ordered regions formed during the initial exposure is also occurring. The real situation is likely to be a combination of development of those pre-existing ordered regions that are sufficiently large to decompose into nanosized d` (causing scattering and a small exothermic contribution), the formation of new congruently ordered regions (causing scattering and a small exothermic event) and the dissolution of the smallest ordered regions (which will lower scattering and result in a net small endothermic event). Additional evidence for a number of convoluted processes occurring can be seen from the irregular shape of initial peak in the DSC thermogram.

As temperature of the isochronal age increases beyond ~400K, the d` grows removing solute from solution and causing the decrease in resistivity and the initial exothermic event at 550K. Dissolution of d` then occurs as the solvus temperature is approached, this results in the second DSC endotherm and the resistivity increase as solute is returned to solution. According to the phase diagram the event observed at higher temperatures results in the precipitation and dissolution of the equilibrium d-phase, this does not feature any further in the current work as commercial heat treatments are designed to avoid production of the equilibrium phase.

Conclusion

The isochronal decomposition pathways leading to the evolution of nanoprecipitation within the Al-Li binary systems are complex and not fully understood. The application of electrical resistivity and differential scanning calorimetric methods provide complimentary data to more conventional electron imaging and diffraction studies. The investigation indicates that the thermodynamic models developed agree with the physical observations; however, there are still areas of uncertainly regarding the specifics of the decomposition mechanisms and the position of the sub-phase boundaries. The results indicate that upon isochronal aging a supersaturated Al-8.7Li At % alloy undergoes a spontaneous ordering process. Uncertainty still exists on

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COLLOQUIA ON COMPOSITES

Siti Haslina Bt Ramli (R), Chairman of the IMM Composites Committee, presiding at the second colloquium

The Composites Committee of the Institute of Materials, Malaysia (IMM) together with The Institute of Materials, Minerals & Mining, (IOM3) and Petronas organised two half -day talks during the first half of the year.

Dr KH Leong (L) with Dr Brett Suddell of IOM3 UK

The first talk by Dr Karen Kozielski & Dr Wendy Tian, 2 senior researchers from the Commonwealth Scientific & Industrial Research Organisation (CSIRO), Australia, was held on 6th February 2009. Karen presented "Toughening of a Carbon Fibre Reinforced Epoxy Anhydride Composite Using an Epoxy Terminated Hyperbranched Modifier" whilst Wendy elaborated on "Accelerated Ageing versus Realistic Ageing in Advanced Composite Materials Hot/Wet Ageing Effects in Low Temperature Cure Epoxy Composites".

On 9 April, 2009, another colloquium entitled "Low Environmental Impact Materials" by Dr Swee L Mak, Deputy Chief (Industry), CSIRO Materials Science and Engineering, CSIRO was held. Dr Mak spoke on how selection of materials, appropriate designs, construction practices, waste generation and service life performance of a structure can impact the environment, especially in construction worldwide. Dr Mak argued that the use of new generation of materials may increased the sustainability of concrete construction.

Dr Brett Suddell of IOM3 UK graced the occasion at this event.

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the pathway by which discrete d` is formed, the results indicating that it could be through the spinodal decomposition of the previously ordered regions, the formation of congruently ordered regions and there subsequent decomposition or a combination of methods. The present research suggests the following decomposition pathway: Spinodal-Ordering → Congruent Ordering + Spinodal Decomposition + Dissolution of Small Spinodally ordered regions → Growth of d` → Dissolution of d` → Nucleation & Growth followed by Dissolution of d phase.

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IMM STUDENT CHAPTERS

Prof Dr Mohd Kamal Harun, Deputy VC (ILC) UiTM

The Institute of Materials, Malaysia (IMM) is always on the lookout to expand its borders, especially through its outreach to the next generation of industrialists and academicians - the students in the universities.

During a meeting with Dr. Mohd. Hasbullah Idris , Prof. Esah Hamzah, Dr. Ali Ourdjini, Prof. Mohd. Kamal Harun, Frankie Chua, Ong Chong Hup and student representatives at the Universiti Teknologi Malaysia Skudai Campus on 29 May 2009, several proposals were made to promote activities amongst students in universities:-

- IMM to assist in sourcing for speakers in industrial talks.
- IMM to assist Student Chapters to source for speakers from industry on current issues for seminars in campus.
- Students join IOM3 UK free-of-charge.
- Student chapters will receive RM5 per year per member as allocation for local student activities.
- Student Chapters will be endorsed officially by IMM.
- Student Chapter will elect their representatives and shall be added into the IMM Newsletter.

A similar initiative was taken by Universiti ITM in Shah Alam, Selangor.

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IMM INSTITUTE OF MATERIALS MALAYSIA

The Malaysian Materials Science & Technology Society (MMS) was registered with the Registrar of Societies on 6th November, 1987. The MMS was actively promoting the awareness of Materials in Malaysia since 1988. In 1996, with a newly-elected Council, the change of name to the Institute of Materials, Malaysia (IMM) was approved on 16th June 1997.

IMM promotes honourable practice, professional ethics and encourages education in materials science, technology and engineering. Engineers, academicians, technicians, skilled workers and professionals are amongst its members exceeding 2200.

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