

PRELIMINARY PROGRAM

---Monday, October 4, 2010---

08:30

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Plenary - Expectation of the Light Metals Industry from the Research Community (MONAM1)

Paper Start Time: 08:30

Paper No.: 5800

Paper Title: **PLENARY: Opportunities and Challenges for the Use of Magnesium in Automotive Applications**

Bob R. Powell; GM Global Research & Development Center;

I will describe the range of new and emerging applications for magnesium in automobiles; overview the progress being made to expand range of applications, and will present the remaining challenges. I will concentrate most on the challenges for powertrain applications but will make mention of other automotive components.

Paper Start Time: 09:20

Paper No.: 5801

Paper Title: **PLENARY: Expectation of the Light Metals Industry from the Research Community - RTA's Perspective**

Paul Henning; BC Operations, RTA;

Abstract not available.

10:30

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Plenary - Expectation of the Light Metals Industry from the Research Community (MONAM2)

Paper Start Time: 10:30

Paper No.: 5802

Paper Title: **PLENARY: Low-Pressure Die-Cast (LPDC) Aluminum Wheels - An Industry Perspective on Surface Defects**

Ken Nguyen; Toyota;

Abstract not available.

14:00

Room: Georgia A (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Aluminum Technology (MONPM1)

Paper Start Time: 14:00

Paper No.: 5623

Paper Title: **Effect of the Temperature and the Stress in Thebehavior In Friction of Metal Matrix Composite**

Jacques Masounave; ETS(Ecole de Technologie Superieur); Boris Rabussier, ETS(Ecole de Technologie Superieur); Jacek Litwin, Cegep St-Laurent; Victor Songmene, ETS(Ecole de Technologie Superieur);

This study is related to the behaviour in friction under various conditions of temperatures and stress of metal matrix composite made of an A356 matrix reinforced with 10 % of silicon carbide particles, of an average size of 15 microns. Using an alternate home made tribometer, the effect of different metals for the shoes, the effect of temperature and applied load were studied. The difference between stage I and II was emphasized. In stage wear rate is independent of the applied stress. A phenomenological relationship was proposed in order to describe the effect of applied stress or temperature on the wear rate in stage II. To obtain a better comprehension of mechanisms of friction and wear, the effect of the tribomicro-mechanical layer was also studied. The competition between chips formation, debris production and stability of the tribo layer is discussed.

Paper Start Time: 14:25

Paper No.: 5620

Paper Title: **Pre-holes Effect on Cutting Forces and Particle Emission During Dry Drilling**

Jules Kouam, ETS(Ecole de Technologie Superieur); Jacques Masounave, ETS(Ecole de Technologie Superieur); Victor Songmene, ETS(Ecole de Technologie Superieur); Alain Giraudeau, ENSAM;

Drill geometry facilitates tool engagement into workpiece, chip evacuation and also the machining process. Pre-holes are sometimes performed in order to improve machining such as process stability but very little is known on its effect on forces and particle emission.

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To do so, pre-holes of size higher or equal to that of drill web size are carried out to eliminate the effect of drill web. The test materials are aluminum alloys (A356-T0, A319-T0, 6061-T6 and 7075-T6) drilled at different cutting speed using uncoated HSS drills. Drilling with pre-holes requires less energy and produces less metallic particles. It is also found that there are two ranges of cutting speeds where the dust production is minimum. Some phenomenological relationships are proposed in order to describe the evolution of loads and particulates emission.

Paper Start Time: 14:50

Paper No.: 5622

Paper Title: Influence of Machining Processes on Particles Emission

Riad Khettabi, ETS(Ecole de Technologie Superieur); Jacques Masounave, ETS(Ecole de Technologie Superieur); Victor Songmene, ETS(Ecole de Technologie Superieur);

The comparison of different processes is the major problem in machining field. The difference of tool geometry, the behavior of work piece material during deformation and the mode of chip formation, are the main difficulties. There is no theory or model that can make an easy transfer between different cutting processes. In order to obtain a process transfer function, one should consider only the main criterion and keep the same parameters for each process. In the current study, the main criterion has to be the particles emission during cutting. It has been found that the classification of process emissivity becomes possible with a corresponding factor and the standard test. The drilling process seems to produce fewer particles than other processes. A simple test has been performed in this paper to evaluate the particles emission and to allow the comparison of different processes. By using this test and the transfer factor, it will be easy to estimate the particles emission for other processes. Additionally, it can be possible to build the emission scale of materials or processes. This scale will take more or less than tow dimension.

15:35

Room: Georgia A (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Aluminum Technology (MONPM2)

Paper Start Time: 15:35

Paper No.: 5326

Paper Title: Solidification Behavior and Redistribution of Al During Horizontal Continuous Casting of AZ61 Magnesium Alloy Plate

Chang Dong Yim, Korea Institute of Materials Science; Sam-Deuk Choi, MetalGenTech Co.Ltd; Jung Eui Lee, MetalGenTech Co.Ltd; Young Min Kim, Korea Institute of Materials Science; Bong Sun You, Korea Institute of Materials Science;

A Computational Fluid Dynamics (CFD) model was developed to analyze the solidification behavior and redistribution of Al during horizontal continuous casting of AZ61 magnesium alloy plate. Redistribution of Al was affected complexly by processing variables and thermodynamic parameters. The maximum content of Al was increased with decreasing of withdrawal velocity and increasing of melt temperature. The redistribution profile of Al in thickness direction of plate was more similar to experimental value measured by ICP in case of non-equilibrium solidification and variable partition coefficient compared to that in case of equilibrium solidification and constant partition coefficient.

Paper Start Time: 16:00

Paper No.: 5300

Paper Title: Solid State Surface Coatings on Magnesium Alloy (ZM21) Using Friction Surfacing

H Khalid Rafi, Indian Institute of Technology Madras; M Arun Shankar, IIT Madras; G.D. Janaki Ram, IIT Madras; K Prasad Rao, IIT Madras; C Ravi Ravindran, Ryerson University, Toronto;

Metallurgically bonded solid state surface coatings of tool steel (H13) and stainless steel (AISI 304) were applied on magnesium alloy (ZM21) substrate by friction surfacing method. In this method neither the coating nor the substrate melts. In view of large differences in physical and mechanical properties between the consumable rod and substrate, friction surfacing was found to be impossible. A technique of preheating the consumable rod using steel startup plate was used to initiate the plastic deformation leading to a successful coating. The bond integrity was found to be 100% by shear test. Bond interface was characterized by optical microscopy and SEM .

Paper Start Time: 16:25

Paper No.: 5303

Paper Title: Development of 7075 Aluminium Alloys for the Thixoforming Process

Amir Bolouri, Mohammad Shahmiri, ; Adel Mohebbati, ;

There is a strong drive to near net shape process 7075 series aluminium alloys, which are currently machined from the wrought state with much waste. Semi-solid processing is one potential near net shaping route. One route to spheroidal semi-solid microstructure is by reheating worked material into the semi-solid state. Here we examine the formation of suitable microstructure for the Semi-solid 7075 aluminium alloy processes. The effects of compression ratio and heating conditions on the microstructure evolution of semisolid Al7075

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alloy produced by the strain induced melt activation (SIMA) process were investigated. Different levels of compression ratio, holding temperatures and holding were used in this investigation. Results revealed that at least 20% compression ratio were necessary in order to obtain uniform and homogenized microstructures during heating in mushy zone. Also the average grain size gradually reduced with the increase of the compressive ratios. While the compressive ratios surpassed 30%, the above descending trend was not as evident as that below 30% reduction. During the subsequent heat treatments the recrystallisation was induced in the deformed samples by the increasingly accumulated strain energy. Quantitative Scanning Electron Microscopy-EDX applied to study the distribution of alloy elements in different holding temperature and holding times.

14:00

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Casting Technology I - Aluminum (MONPM1)

Paper Start Time: 14:00

Paper No.: 5410

Paper Title: **Determination of the Optimal Location to Monitor Temperature during Low Pressure Die Casting**

XinMei Shi; UBC; Guy Dumont, UBC; Daan Maijer, UBC;

Controlling and eliminating defects, such as macro porosity, in Low Pressure Die Casting (LPDC) is an on-going challenge that manufacturers must continually address. Since macro porosity caused by liquid encapsulation cannot be directly measured during casting, die temperature is typically monitored to assess the state of an operational casting process and with suitable analysis may be used as an indirect indicator of shrinkage. In this work, a model-based methodology is employed to analyze the correlation between die temperature and encapsulated liquid volume. This methodology is then used to assess the effectiveness of temperature monitoring at different locations in a die to predict encapsulated liquid volume. Based on this analysis, the optimal location to monitor temperature for the purpose of minimizing macro porosity has been determined. The proposed technique has been tested with a model of a low pressure die casting purposely designed to be susceptible to macro porosity.

Paper Start Time: 14:25

Paper No.: 5399

Paper Title: **Effect of Zr on Primary Intermetallic Formation and Grain Refinement of AA7003 Alloy**

Martin Fortier, Rio Tinto Alcan Inc., Arvida Research and Development Center; X. Grant Chen, Université du Québec a Chicoutimi; Adel Mohamed, Université du Québec a Chicoutimi;

The microstructure and properties of Al-5.7%Zn-1%Mg (AA7003) alloy are strongly affected by adding small quantities of microalloying element of Zr. The formation temperature and morphology of primary ZrAl₃ were studied using thermodynamic calculations and metallographic examinations on quenched samples. Optical microscopy and scanning electron microscope techniques were used to allow for an assessment of the microstructural changes of ZrAl₃ intermetallic precipitation during solidification. In addition, the effect of Zr additions on grain refining of α -Al was investigated. The results showed that primary ZrAl₃ particles depict several morphologies, such as blocky, petal-shaped, branched plate, and needle/plate like form. The formation temperatures of ZrAl₃ phase determined by the experiment agree well with that of the thermodynamic calculation up to 0.26% Zr. The results also indicated that a significant refinement of the grain size of α -Al had been achieved at Zr contents of 0.05 to 0.15wt%.

Paper Start Time: 14:50

Paper No.: 5139

Paper Title: **Numerical Modelling of the Casting Operation at IMASA Shop**

Gabriel Plascencia; University of Toronto; Claudio Méndez, CIITEC-IPN; Cuauhtémoc Sánchez, CIITEC - IPN; Marco Antonio Rubio, IMASA; David Jaramillo, CIITEC - IPN;

Numerical simulations of the semicontinuous (open mould) casting of 1XXX aluminium alloys were performed in order to improve the casting operation at an aluminium casting shop. Several calculation runs were conducted; in the first ones, current operational conditions were used as boundary conditions. The results from these initial trials are in good agreement with temperature measurements made on site. Once the model satisfied the shops operation conditions, new sets of boundary conditions were imposed to the model with the purpose of enhancing the cooling conditions of the casting operation. Results show the feasibility of improving the cooling system currently in place.

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Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Casting Technology I - Aluminum (MONPM2)

Paper Start Time: 15:35

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Paper No.: 5138

Paper Title: Effect of the Cooling Rate on the Microstructure of Aluminium Bars Continuously Casted

Gabriel Plascencia; University of Toronto; Claudio Méndez, CIITEC - IPN; Mitzi Ríos, UAM - Azcapotzalco; Miguel Ángel Barrón, UAM - Azcapotzalco; Alberto Torres, UASLP; David Jaramillo, CIITEC - IPN;

Aluminium alloys ingots are widely manufactured by semicontinuous casting operations. Due to its size, it is difficult to evaluate the effect of the cooling water flow rate on the microstructure of the resulting ingot. In this paper, we report the effect of the flow rate of the cooling water as well as the casting velocity on the microstructure of bars made from aluminium alloys from the 1XXX and 3XXX series, after being casted in a laboratory scale continuous casting machine. Results show that the microstructures obtained under different casting conditions, are independent of the process variables. Furthermore, it was found a homogeneous microstructure throughout the casted bars with no indication of dendritic growth.

Paper Start Time: 16:00

Paper No.: 4991

Paper Title: A Model of Semi-solid Deformation Using a Discrete Element / Finite Element Approach

Meisam Sistaninia; Computational Materials Laboratory, Ecole Polytechnique Fédérale de Lausanne; A.B. Phillion, School of Engineering, University of British Columbia Okanagan, Kelowna, Canada; J.-M. Drezet, Computational Materials Laboratory, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland; M. Rappaz, Computational Materials Laboratory, Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland;

A 3D model has been developed to predict the mechanical behaviour of semi-solid globular grains during solidification. This model uses granular techniques based on a combined Finite Element / Discrete Element formulation in order to investigate semi-solid deformation at a given fraction of solid. The intergranular liquid is modelled as the combination of a damper and a spring element while the solid grain behavior is approached with an elasto-viscoplastic law. It is shown that, domain must include at least 700 grains in order to accurately model semi-solid behaviour. It is also shown that a normal spring element, with no tangential forces, can be used to approximate hydrostatic behaviour.

Paper Start Time: 16:25

Paper No.: 5579

Paper Title: Spacing Selection in Upward Directional Solidification of Al-Cu Alloys Under Transient Conditions

Morteza Amoorezaei; McMaster University; Sebastian Gurevich, McMaster University; Nikolas Provas, McMaster University;
We study the relationship between the microstructure and cooling conditions in unsteady state directional solidification of Al-Cu. We find that the final microstructure under transient conditions is strongly dependent on the history of the growth conditions changes and the initial morphology of the system, consistent with the results previously obtained by Warren and Langer and Losert et. al. We also present new phase field simulations wherein we dynamically vary the cooling conditions. Our phase field results are validated qualitatively by the experiments under nearly the same growth conditions. These results, however, is not consistent with the previously obtained geometrical models.

Paper Start Time: 16:50

Paper No.: 5729

Paper Title: Effect of Cooling Circuit Duration on Formation of Solidification Shrinkage in A356 Casting Automotive Wheels

J. R. Lee; AUT University; Darius P. K. Singh, Institute of Industrial Innovation (I-cubed), AUT University; Zhan W. Chen, School of Engineering, AUT University;

Low Pressure Permanent Mould Casting (LPPM) is a widely used process to produce structural components for automotive applications. The combination of and cooling circuits ensures comparably faster cooling rates of permanent mould casting than gravity sand casting. As a result much better mechanical property is achieved using LPPM process. Cooling circuits are also placed in strategic locations in the tooling to minimise casting defects such as solidification shrinkage. The effects of cooling circuits are controlled by the following control parameters cooling fluid media, flow rate of cooling fluid and duration of cooling. In this paper, the impact of cooling circuit duration on controlling shrinkage for automotive wheel casting is investigated. The effect of varying degree of cooling circuit duration is quantified by secondary dendrite arm spacing (SDAS) measurements of casting samples. Discussions on more effective cooling strategy for casting component are also presented.

---Tuesday October 5, 2010---

08:30

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Casting Technology II - Aluminum (TUESAM1)

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Paper Start Time: 08:30

Paper No.: 5147

Paper Title: **The Benefit of Low Pressure Casting when Producing Thin Light Metal Parts**

Bernard Duchesne, Cégep de Trois-Rivières; Nicolas Giguère, Centre Intégré de Fonderie et de Métallurgie; Jocelyn Baril, TMA Inc.; Franco Chiesa Chiesa, Centre Intégré de Fonderie et de Métallurgie;

The advantage of the Low Pressure Process when producing very thin castings (2mm walls) in permanent mould will be demonstrated via two case studies involving the production of a high end electronic casing grid and of an aircraft seat housing. Filling simulations will be used to determine the process conditions which will robustly produce castings free of cold shuts. Finally, the metallurgical properties will be measured in various part of the castings and compared to the values predicted by solidification modeling.

Paper Start Time: 08:55

Paper No.: 5435

Paper Title: **Effect of Oxide Films on Microporosity Formation in A356 Aluminum Alloy Castings**

Lu Yao; University of British Columbia; Steve Cockcroft, University of British Columbia; Daan Majjer, University of British Columbia;

In this work the effect of metal cleanliness on the final pore size distribution in aluminum alloy castings was studied. Directionally solidified A356 samples were cast under three inclusion levels. The type and content of inclusions were determined by porous disc filtration analysis (PoDFA). The cast porosity volume fraction, size distribution and morphology were measured by the X-ray microtomography and compared under the three different casting conditions. By fitting the experimental results against the numerical model based on previous work, the variation of microporosity nucleation site distribution with inclusion content in the melt was also revealed.

Paper Start Time: 09:20

Paper No.: 5206

Paper Title: **Effect of Grain Refinement on Residual Strain and Hot Tearing in B206 Aluminum Alloy**

Francesco D'Elia; Ryerson University; Comodore Ravindran, Ryerson University;

B206 is an Al-Cu alloy that is envisaged for use in automobiles as suspension knuckles and control arms. The main shortfall of this alloy however, is its high susceptibility to hot tearing. Grain refinement has been shown to reduce hot tearing severity in Al alloys. In the present study, Ti-B grain refiner was added to B206 to investigate the effect on hot tearing. Further, residual strain was measured using neutron diffraction and correlated to hot tear formation. The results suggest that grain refinement significantly reduced hot tears in B206 and produced a more uniform distribution of strain along the casting.

Paper Start Time: 09:45

Paper No.: 5369

Paper Title: **Measuring the Interdendritic Permeability and Assessing the Feedability of Simulated Al-Cu Alloy Microstructures**

Ehsan Khajeh; University of British Columbia; Daan M. Majjer, University of British Columbia;

The interdendritic permeability is a critical parameter that defines the feedability of the mushy zone during solidification. In this study, the evolution of permeability during dendritic solidification of Al-Cu alloys has been measured with a physical modeling approach. Three-dimensional geometry of solidified eutectic/primary phases was obtained by X-ray microtomography and has been employed as an initial condition for simulating dendritic solidification using the Monte Carlo technique. Large-scale, physical replicas of the simulated structures have been constructed using a rapid prototyping technique. The mushy zone permeability of these replicas has been calculated by measuring the pressure drop and flow rate when a glycerin solution is passed through the physical model. The permeability values have been used to calculate the feeding distance for various solidification conditions. Considering experimental difficulties associated with direct measurement of permeability, the current approach provides a more accurate means of assessing feeding behavior.

10:30

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Casting Technology II - Aluminum (TUESAM2)

Paper Start Time: 10:30

Paper No.: 5517

Paper Title: **Effect of Mn and Si on Iron-rich Intermetallics in Cast 206 Aluminum Alloys**

X. Grant Chen; Université du Québec à Chicoutimi; Kun Liu, University of Québec at Chicoutimi; Xinjin Cao, NRC Institute for Aerospace Research; X. Grant Chen, University of Québec at Chicoutimi;

Effect of Mn and Si on the formation of iron-containing intermetallic phases has been investigated in Al-4.5%Cu (206) alloy with 0.3% Fe. The iron-containing intermetallics are identified and characterized by using thermal analysis (TA), differential scanning calorimetry (DSC), optical microscope, scanning electron microscope (SEM) and image analysis techniques. It is found that two types of iron-containing intermetallic phases exist in the final solidified structures: platelet β -Fe (Al₇Cu₂Fe/Al₇Cu₂(FeMn)) and Chinese script α -Fe

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(Al₁₅(FeMn)₃(SiCu)₂). Addition of either Mn or Si favors the transformation of β-Fe phase into α-Fe phase but Mn is more effective than Si. At a combined addition of both Mn and Si to a certain amount, almost all platelet β-Fe can be converted into Chinese script α-Fe. For a cast of Al-4.5Cu-0.3Fe alloy, 0.3% Mn and 0.3% Si are required to completely suppress the β-Fe phase.

Paper Start Time: 10:55

Paper No.: 5519

Paper Title: Solidification Analysis of Al-Si Alloy Using In-situ Neutron Diffraction

Wojciech Kasprzak; CANMET-MTL, Natural Resources Canada;

In-situ neutron diffraction and thermal analysis techniques were used to evaluate the kinetics of the non-equilibrium solidification process of hypereutectic Al-Si alloy using NRU nuclear reactor in Chalk River, ON and HFIR reactor in Oak Ridge National Lab, TN. Neutron diffraction patterns were collected in the stepwise mode during solidification between 740 and 400°C. The variation of intensity of the diffraction peaks was analysed and compared with the results of a conventional cooling curve analysis. It was shown that neutron diffraction offers potential for high resolution liquid and semi-solid microstructure analysis and can be used for novel studies on grain refining, eutectic modification, etc.

Paper Start Time: 11:20

Paper No.: 5650

Paper Title: Numerical Model of the Evolution of Near - Surface Microstructure

R.W. Smith; Queen's University;

In the present study, the Monte Carlo method was applied to simulate the dynamics of the nucleation and grain growth processes near the surface of a casting forming adjacent to a chill block. This micro-model was coupled with a macro-model which described the solidification process of the casting and the heat transfer processes in both the chill block and the casting. The interactions between microstructure evolution and the macro-transport processes were realized by transferring the data between the two models. The modeling results were verified by experiment on an Al-4.5% Cu alloy. The effects of the mold texture and mold preheat temperature on microstructure development are illustrated by the modeling results.

14:00

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Casting Technology I - Magnesium (TUESPM1)

Paper Start Time: 14:00

Paper No.: 5263

Paper Title: Improvements in Grain Refinement of AZ91E

Kenneth Lee; Ryerson University; C. Ravi Ravindran, Ryerson University; B.S. Murty, IIT Madras;

Effective grain refiners for magnesium-aluminum systems will enable greater applications of these alloys. Novel additions of Al-Al₄C₃, Al-5TiB-2 and ZnO were separately investigated for their enhanced grain refinement of AZ91E. AZ91E melts with the additions were poured at 720°C into graphite molds pre-heated to 750°C. For each addition level, holding times at 720°C were 5, 10 and 20 minutes. All additions showed significant grain refinement of the base metal. ZnO at 2wt.% yielded the smallest average grain size of 191µm compared with the base metal at 782µm. Results of SEM, light optical microscopy, hot tearing and mechanical testing are presented.

Paper Start Time: 14:25

Paper No.: 5440

Paper Title: Influence of Silicon on the Microstructure and Mechanical Properties of Lost Foam Cast AE42 Magnesium Alloy

Anthony Lombardi; Ryerson University; Sophie Lun Sin, Ryerson University; Comodore Ravindran, Ryerson University;

AE42 is a magnesium alloy that was developed for elevated temperature applications, however its castability is poor and its mechanical properties deteriorate rapidly above 150 °C. In order to improve the mechanical properties and castability of AE42 in lost foam casting, varying amounts of silicon (0.3, 0.7 and 1.0 wt% Si) were added to the base alloy resulting the formation of an Al-Si-RE phase. Optical and scanning electron microscopy indicated that there was a progressive coarsening of the magnesium dendrites. This caused the tensile strength to decrease but the ductility to increase at ambient temperature.

Paper Start Time: 14:50

Paper No.: 5200

Paper Title: Effect of Al-Ti-B Based Grain Refiners on the Hot Tearing Susceptibility of AZ91E Magnesium Alloy

Abdallah Elsayed; Ryerson University; B.S Murty, Indian Institute of Technology - Madras; Comodore Ravindran, Ryerson University;

Magnesium alloys have poor castability resulting in hot tearing during permanent mold casting. In this study, the effect of Al-5Ti-1B and Al-1Ti-3B grain refiners on the hot tearing susceptibility of AZ91E magnesium alloy was investigated. The permanent mold castings were produced with a pouring and mold temperature of 720°C and 180°C respectively and characterized using SEM, TEM and optical

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microscopy. The base AZ91E castings contained severe hot tears. With Al-5Ti-1B addition no significant reduction in hot tearing was observed because of large, brittle TiAl₃ particles at the grain boundaries. With Al-1Ti-3B addition, hot tearing was reduced because of a decrease in the casting grain size and the absence of detrimental intermetallics. A decrease in the hot tearing susceptibility of AZ91E permanent mold castings enables the production of complex components for use in automotive and aerospace vehicles.

15:35

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Casting Technology I - Magnesium (TUESPM2)

Paper Start Time: 15:35

Paper No.: 5148

Paper Title: **Modification of As-cast Microstructure of AZ91-1Si Magnesium Alloy Using Al-5Ti-1B Master Alloy**

Sophie Lun Sin; Ryerson University; Saad Khan, Ryerson University; Comodore Ravindran, Ryerson University;

The quest to improve the elevated temperature properties of magnesium alloys has resulted in the introduction of Mg-Al-Si alloys. However, the processing of these alloys is limited to die casting, since the formation of undesirably, coarse Chinese script Mg₂Si phase leads to poor mechanical properties. Modification and refinement of Mg₂Si phase could improve the mechanical properties of Mg-Al-Si alloys. In this investigation, varying amounts (0.5-1.5 wt%) of Al-5Ti-1B master alloy were added to AZ91E magnesium alloy with 1 wt% silicon. Results showed that Al-5Ti-1B modified the Mg₂Si phase from Chinese script to polygonal shape, leading to enhanced mechanical properties.

Paper Start Time: 16:00

Paper No.: 5425

Paper Title: **Magnesium Chloride Dehydration Using the Fluidized Bed Technology**

Kamal Adham; Hatch Ltd; Cassandra Lee, Hatch Ltd.;

Magnesium metal is commonly produced through the molten salt electrolysis of MgCl₂. The feed to electrolysis must be dry with minimum oxygen content. Drying the hydrated chloride (MgCl₂·6H₂O) is a challenging process, due to the great tendency of MgCl₂ to undergo pyrohydrolysis (thermal degradation with H₂O), when heated. Fluidized bed dryers are often used (under air or HCl atmosphere) to achieve the target dehydration. This paper addresses the key features of three (3) different types of fluid bed technologies which can be applied to MgCl₂ dehydration plants, with a discussion of chemistry, unit operation and advantages associated with each option.

Paper Start Time: 16:25

Paper No.: 5366

Paper Title: **The Effect of Nd and Sr on the High Temperature Oxidation and Ignition Behavior of Magnesium**

Deniz Temur; McGill University;

This study aims to investigate the effects of various levels of Nd and Sr additions on the oxidation and ignition behavior of magnesium alloys. The oxidation tests were conducted at 773K in dry air flow for 12h. Scanning electron microscopy (SEM), electron probe micro-analysis (EPMA), glancing angle X-ray diffraction (XRD) and thermogravimetric analysis (TGA) techniques were used to determine the oxidation mechanisms. Results showed that high level of Sr improved the oxidation resistance with the development of a compact layer on the external surface. On the other hand, no significant improvement was observed with the increase in Nd content of magnesium alloy.

Paper Start Time: 16:50

Paper No.: 5495

Paper Title: **Grain Refinement of Cast Magnesium Alloy by the Addition of Foreign Particle**

Young-Min Kim; Korea Institute of Materials Science; Ling Wang, Korea Institute of Materials Science; Chang Dong Yim, Korea Institute of Materials Science; Bong Sun You, Korea Institute of Materials Science;

Grain refining technique leads to improving both properties and formability of cast magnesium alloy. Several kinds of particles such as carbon, carbides, carbonates, etc. were used, and their grain refining efficiency for cast magnesium alloys was evaluated in this study. The results show that the carbon-containing particles have excellent grain refining efficiency in Mg-Al base alloys, of which average grain size is less than 70µm. This is because foreign particles themselves can become potent nuclei of Mg grains or they can contribute to the in-situ formation of effective heterogeneous nuclei, depending on their stability in a melt.

---Wednesday October 6, 2010---

PRELIMINARY PROGRAM

08:30

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Thermomechanical Properties (WEDAM1)

Paper Start Time: 08:30

Paper No.: 5160

Paper Title: **Precipitation Hardening in Mg-Zn-RE Alloys**

Brian Langelier, University of Waterloo; Shahrzad Esmaeili, University of Waterloo;

The desire to improve vehicle efficiency by reducing mass has led to increased interest in magnesium as a lightweight alloy. However, further utilization of magnesium alloys is limited by their low strength and poor formability. The alloys investigated in this study are based on the Mg-Zn system, and are designed for increased strength through precipitation hardening. Although precipitation hardening is typically limited in magnesium alloys due to precipitate type and orientation, it can be dramatically enhanced by the addition of microalloying elements. In this work, rare-earth elements are used as microalloying additions, which have the added benefit of improving formability by promoting a random texture. The precipitation hardening behaviour of selectively designed alloys is investigated using calorimetry and transmission electron microscopy methods and the results are discussed based on the thermodynamic and kinetic aspects of transformation.

Paper Start Time: 08:55

Paper No.: 5414

Paper Title: **Hot Strength and Microstructures of AA6060 at High Strains/Rates**

Hugh J. McQueen, Concordia University; Sophie Gourdet, EADS Innovation Works-Suresnes;

The hot-working constitutive and ductility behavior of 6060 is compared to stronger 6000, 2000, 7000 and 5000 alloys: moderate strength 6060 has low alloying additions (0.48 Mg, 0.43Si). The range of workabilities arising from various precipitate distributions and solute levels is explained to provide a guide for heat treatment prior to forming. The microstructural evolution that supports such mechanical behavior is presented in comparison to commercial Al. In addition to steady-state subgrain characteristics such as size, misorientation and internal dislocation density, alterations with strain in high-angle boundaries of grains and of deformation bands receive special attention. Application to extrusion, which is the principal shaping process for 6060, and to rolling are discussed.

Paper Start Time: 09:20

Paper No.: 5352

Paper Title: **Effects of Varied Sn- and Cu-content in Lead-free Al-Cu Based Alloys Intended for Free Machining**

Susanne Koch, University of Leoben - Nonferrous Metallurgy; Helmut Antrekowitsch, University of Leoben - Nonferrous Metallurgy;

Due to current EU-guidelines, which demand avoidance of hazardous substances, new sustained materials have to be developed. Particular attention of RoHS and ELV is paid on the utilization of lead in aluminium alloys. Material technologists are committed to decrease the amount of lead to the required minimum. This paper deals with the microstructure of AlCuMgSn-alloys, which were developed to accomplish a free-cutting alloy with good machinability without adding toxic lead as a chip breaking inclusion. The main focuses are machinability, anodization behaviour as well as phase characterisation depending on the varied content of the alloying elements Sn and Cu. The cutting properties are more enhanced with increasing Sn than rising Cu content. Samples after VDA 621-415 alternating testing show a protective action of hard anodizing layer on all Sn-containing materials.

Paper Start Time: 09:45

Paper No.: 5559

Paper Title: **Effect of Strontium on the Properties and Extrusion Behavior of Mg-Mn Alloys**

Hemant Borkar, McGill University; Mihriban Pekguleryuz, McGill University;

Wrought Mg alloys have received increasing attention for automotive applications for past few years due to their potential for weight reduction. Several magnesium extrusion alloys which are currently used in the automotive applications do not have a good combination of mechanical properties and extrudability. The Mg-1Mn (M1) alloys offer good formability; however, the low strength offered by this alloy is a major concern. Extrusion of Mg alloys gives strong final texture where basal planes and directions align with the extrusion axis resulting in tensile-compressive yield asymmetry. It has been experimentally established that the addition of rare-earth elements such as Ce, Nd and Y to Mg alloys weaken the texture and improve the formability in both extrusions and in rolled materials. Sr behaves similarly to rare earth (Ce group) elements and is expected to have beneficial effect in Mg-Mn alloys. The effect of Sr in Mg-Mn alloys has been studied with Sr additions up to 2wt%. Grain refining is observed in cast alloys with increasing additions of Sr. The microstructures of cast Mg-Mn-Sr alloys are investigated and texture of compressed and extruded alloys is compared.

10:30

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

PRELIMINARY PROGRAM

Session: Thermomechanical Properties (WEDAM2)

Paper Start Time: 10:30

Paper No.: 5536

Paper Title: The Effect of Composition on the Texture Evolution of Hot-deformed Mg-Zn-Y Alloys

Amir Farzadfar, McGill University; Mehdi Sanjari, McGill University; In-Ho Jung, McGill University; Steve Yue, McGill University;

Magnesium alloys are excellent candidates for applications where weight saving is of major importance. However, the industrial use of Mg sheets is limited due to the development of a strong basal texture. It has recently been observed that a weaker texture develops in Mg-Zn alloys containing rare earth (RE) elements; however, the responsible mechanism(s) are not clearly understood. This research involves studying the effect(s) of RE intermetallics and solutes on the microstructure and texture evolution during and after hot deformation in Mg-Zn-Y alloys. To achieve this, the alloy selection will be performed by CALPHAD method in order to obtain alloys containing either different types of RE intermetallics or different solutes (Zn or Y) in Mg solid solution to separately study the effect(s) of RE intermetallics and solutes. The evolution of microstructure and texture after hot compression and subsequent annealing will be investigated by means of XRD, SEM and EBSD technique.

Paper Start Time: 10:55

Paper No.: 5700

Paper Title: Thermo-mechanical Stability of Four Aluminum Alloy Brazing Sheets at Elevated Temperatures

Peyman Ashtari, CANMET Materials Technology Laboratory; Mark S. Kozdras, Dana Canada Corporation; Kevin P. Boyle, CANMET Materials Technology Laboratory; Kumar Sadayappan, CANMET Materials Technology Laboratory;

Turbocharging and technologies such as exhaust gas recirculation (EGR) represent effective strategies for increasing engine efficiency, as greenhouse gas emissions can be reduced in a manner similar to competing technologies, but generally at a lower cost. Thermal management components, which can withstand increased temperature and pressure, are integral to turbocharger systems and required for increased engine efficiency. Aluminum alloy brazing sheet is a candidate material for thermal management components due to inherent light weight and high thermal conductivity. However, the use of aluminum sheet alloys for components such as heat exchangers and charge air coolers is currently limited at high temperatures due to the potential for thermo-mechanical degradation and consequent in-service life reduction. In the present study, thermo-mechanical stability of four candidate aluminum brazing sheet alloys has been investigated. The samples were exposed for 48, 100, 500 and 1000 hrs to temperatures of 177, 205, 235 and 260 °C. Following the exposure, mechanical strength was studied at both room and elevated temperatures. Mechanical properties were correlated to differential scanning calorimetry (DSC) measurements. Strength and hardening were commensurate with the precipitation kinetics of the tested alloys as measured with DSC; a loss of mechanical strength occurred above 205 °C for all alloys tested due to precipitate dissolution and grain growth. Finally, we discussed how the results can be used for the intelligent design of heat exchanger components.

Paper Start Time: 11:20

Paper No.: 5546

Paper Title: Texture and Microstructural Evolution During High Strain Rate Hot Deformation of AZ31 Mg Alloys

Mehdi Sanjari, McGill University; Amir Farzadfar, McGill University; Steve Yue, McGill University; Elhachmi Essadiqi, NRCAN;

In this work, the effect of strain rate on the plastic flow behavior, static and dynamic restoration kinetics and features and texture evolution was investigated for a wide range of strain rates. The low strain rate deformation behavior was investigated by MTS hydraulic test machine, in single and double hit compression tests at two strain rates of 1 and 0.01s⁻¹ temperatures of 150, 250, 350 and 450 degrees celsius. To study the effect of strain rate in range of 10-200 s⁻¹, single and double hit compression tests are performed using the cam plastometer. To measure texture and microstructure evolution, EBSD, optical microscopy is being used. The results show that the most uniform microstructure was obtained at strain rate of 60s⁻¹ and temperature of 370 degrees celsius. The recrystallization mechanism is twinning induced DRX at high strain rate of 100s⁻¹.

13:10

Room: Georgia A (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: General Light Metals (WEDPM1)

Paper Start Time: 13:10

Paper No.: 4966

Paper Title: Dissolution and Reaction in Early Stage of Solid Iron-liquid Aluminum Contact

Alireza Shahbazi, Tarbiat Modares University; Hamidreza Shahverdi, Tarbiat Modares University;

Dissolution and formation of intermetallic compounds (IMCs) during solid iron-liquid aluminum contact is studied in this research; and tried to have better knowledge from early stage phenomenon of solid iron-liquid aluminum contact meanwhile structural identification experiments in interface. So, the reactions between solid iron immersed in liquid aluminum in 750oC, 800 oC and 850 oC without

PRELIMINARY PROGRAM

turbulence were studied; and using optical microscope (OM), scanning electron microscope (SEM) and electron probe micro analyze (EPMA) the formed structures in iron-aluminum interface and in aluminum phase was studied. The results of experiments show that the intermetallic has seen clearly, at least in some regions of interface after 10 seconds; and formation and development of compound layer in interface requires no saturation of iron with aluminum in immersion temperature. In other hand, decomposition and engraving of some regions of intermetallic is the main mechanism of entrance of iron into aluminum. The witnesses show the existence of a saturated layer of iron in iron-aluminum interface before formation of IMCs and dissolution of iron in liquid aluminum.

Paper Start Time: 13:35

Paper No.: 5223

Paper Title: Age Forming of Airfoiled and Twisted Titanium Parts

Mansoor Shirjazi; Department of Materials Engineering, Isfahan University of Technology; Mahmood - Farzin, Department of Mechanical Engineering, Isfahan University of Technology;

Titanium and its alloys have numerous applications in aviation industries, due to their unique physical, mechanical and metallurgical properties. Forming of sheet metal parts and components from these alloys has many complex technical problems. Limits in cold forming, high spring-back, atmospheric gases absorption and brittleness at high temperature, rapid temperature reduction are some examples of these problems. Especially for airfoiled twisted sections with high length to cross section (l/A) ratio, thick parts and limiting aviation standards, above mentioned problems are more pronounced. So forming and manufacturing of these types of parts with conventional forming processes are impossible and nonconventional techniques should be proposed. In this paper, age forming of Ti-6Al-4V is investigated and suggested. This method not only omits above mentioned problems but also has some advantages. The advantages are omitting heavy press machines and isothermal equipments, removing spring-back and providing the desired airfoil and twist geometry completely. To validate the presented technique untwisted, airfoiled specimen with 20 cm, 40 cm widths, and also a twisted 40 cm width specimen were prepared and formed and measured. Finally a new technical age forming procedure was put forward that can be used for similar parts.

Paper Start Time: 14:00

Paper No.: 5227

Paper Title: Solubility and Stability of Friedel's Salt (FS: $3\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{CaCl}_2 \cdot 10\text{H}_2\text{O}$) in NaOH, NaCl and NaNO₃ Solutions

Zhibao Li; Institute of Process Engineering, Chinese Academy of Sciences; Yu Jia Ma, Institute of Process Engineering, Chinese Academy of Sciences;

In order to prevent scaling or alumina quality issues, controlling silica level in Bayer liquor is critical. It was found that Friedel's salt had a relatively high desilication capacity in a previous work. In this work, the solubility of Friedel's salt in NaOH, NaCl and NaNO₃ solutions was measured by using the classic isothermal dissolution method over the temperature range from 293 to 473K, and the solubility product of Friedel's salt, $\log_{10}K_{sp}$ (FS) was calculated by the OLI software. The hexagonal Friedel's salt used in this work was prepared by the reaction of CaCl₂ with NaAlO₂. The concentration ranges studied are up to 5mol/dm³ for NaOH and 2.5 mol/dm³ for NaCl, NaNO₃. The solubility of Friedel's salt in all cases investigated was found to increase with temperature. The solubility of Friedel's salt in pure water initially increases to a maximum value and then decreases with an increase of the temperature. In NaOH and NaCl solutions, the solubility of Friedel's salt was found to decrease with increasing the NaOH and NaCl concentrations due apparently to common effect. It was further found that the addition of NaNO₃ causes the solubility of Friedel's salt to increase due to complexation. In addition, the experimental data were predicted with the help of OLI platform. It was shown that the experimental data agree with the predicted values with the exception of Friedel's salt in NaOH solution. XRD and SEM examination of the equilibrated solids showed that Friedel's salt is stable in all cases.

Paper Start Time: 14:25

Paper No.: 5257

Paper Title: Mechanical Properties of A356 Aluminum Alloy Produced Using a Novel Thixoforming Process

Alireza Fadavi Boostani; Isfahan University of Technology; Saleh Tahamtan, Isfahan University of Technology,

In the present work, a novel thixoforming process for semi-solid deformation of A356 aluminum alloy is introduced. Obtained results showed that this process produces fine and compact silicon particles dispersed uniformly in the microstructure of the alloy and production stages of these silicon particles were well documented using presented hypothesis. A new combination parameter, named silicon density ratio (SDR) index, was introduced. This parameter correlates the mechanical properties of samples to morphological properties of silicon particles and density ratio of samples. It has been shown that samples with low SDR index have superior mechanical properties and consequently intergranular fracture mode.

Paper Start Time: 14:50

Paper No.: 5258

Paper Title: Mechanical Properties of A356 Thixo/rheoformed Alloys Produced by SIMA Process

Alireza Fadavi Boostani; Isfahan University of Technology; Saleh Tahamtan, ;

In the present study, the effect of thixo/rheoforming process on microstructure, mechanical properties and fracture mode of A356

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thixoformed alloy produced by SIMA process was investigated. Obtained results showed that thixoforming process can be very beneficial in improving mechanical properties of A356 alloy in comparison to conventional casting processes. According to fractographic examinations it has been cleared that fracture path in thixoformed samples tends to concentrate along the grain boundaries leading to intergranular fracture mode. The transition from transgranular (gravity cast sample) to intergranular (thixoformed sample) fracture is accompanied by an increase in the ductility of the A356 alloy.

15:35

Room: Georgia A (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: General Light Metals (WEDPM2)

Paper Start Time: 15:35

Paper No.: 5259

Paper Title: **Effect of Heat Treatment on Mechanical Properties and Fracture Behavior of Thixoformed A356 alloy**

Saleh Tahamtan; Isfahan University of Technology (IUT); Alireza Fadavi Boostani, Isfahan University of Technology (IUT);

In this research work, semi-solid A356 alloy was reheated to 590°C or 600°C, held at these temperatures for 10 min and 50% hot working was applied. Effects of T6 treatment, microstructural features and reheating temperature on mechanical properties and fracture behavior were investigated quantitatively and compared with that of rheocast and gravity-cast samples. The present observation suggest that tensile cracks were initially formed in the eutectic area and propagated through either shearing or following primary alpha phases. Differences observed in the tensile fracture path are attributed to microstructural changes as well as morphological aspects of silicon phase.

Paper Start Time: 16:00

Paper No.: 5260

Paper Title: **Effect of Microstructural Properties on Pitting Corrosion of Thixoformed A356 Alloy**

Saleh Tahamtan; Isfahan University of Technology (IUT); Alireza Fadavi Boostani, Isfahan University of Technology (IUT);

In this study, semi-solid A356 alloy was reheated to 590°C or 600°C, held at these temperatures for 10 min and 50% hot working was applied. Pitting behavior of thixoformed A356 alloy, with different reheating temperatures, was evaluated and compared with the pitting behavior of rheocast and gravity-cast A356 alloy quantitatively. Linear sweep voltammetric (LSV) tests were performed on all samples. To facilitate the measurement of galvanic corrosion current, a simulation model was used. These results relate pitting corrosion behavior of thixoformed, rheocast and gravity-cast A356 alloy to their microstructure characteristics using a new parameter in the form of L/DV.

Paper Start Time: 16:25

Paper No.: 5279

Paper Title: **Environmental Impacts of the Ilmenite Concentration Plant in Kahnooj, Iran**

Behzad Sedaghat; RECo; Ali Farahmand, MKPK; Behzad Sedaghat, RECo; Davood Moradkhani, RECo; Ali Rashtchi, RECo;

An ongoing challenge in many mineral processing plants is their impacts on the environment. In order to produce Ilmenite concentrate from the Kahnooj Ilmenite deposit in Iran. In this flowsheet Ilmenite is concentrated by LIMS, HGMS, shaking tables, electrostatic separator, and flotation of fines. The solid waste is produced by HGMS and flotation. In this research, solid wastes were checked by EPA 1310 standard to make sure if they drained any toxic elements. The results showed that the grade of Zn and Ca in both solid wastes are a little higher than the standard grade in surface water, but Mg, Mn and Fe levels were acceptable.

Paper Start Time: 16:50

Paper No.: 5424

Paper Title: **Effect of Mushy Zone on Pore Morphology of Lotus-type Porous Mg-Si System**

Yoonas Kabiri; Mahmood Meratian, IUT; Mohsen Mohammadi, IUT; Farshid Mirshahi, IUT;

There has been a great interest in fabrication of porous metals as it opens a new path for lightweight structural materials. Recently, a new type of porous metal with long cylindrical pores aligned in one direction has been produced by unidirectional solidification system in hydrogen atmosphere under high pressure. In present study, three alloy composition of Mg-Si system with different mushy zones were studied. Then the effect of mushy zone on the porosity and the pore morphology was investigated. The results showed that pore diameter and the pore number density were significantly affected by the mushy zone.

Paper Start Time: 17:15

Paper No.: 5453

Paper Title: **Synthesis of Particulate in Situ Aluminum-alumina Composite by Using Aluminothermic Reaction of Multi Powder Mixture**

Mohsen Sanayei; Isfahan University of Technology; Mahmood Meratian, Isfahan University of Technology; Masoud Panjepour, Isfahan

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University of Technology;

Particle reinforced metal matrix composite (MMCs) are an important class of composite materials. One of the best ways for producing cast particulate composites is In-Situ methods. In this study, In-situ particle-reinforced aluminum based cast composites have been synthesized by dispersion of externally added Zinc Oxide particles into molten aluminum. Alumina particles form through chemical reaction of ZnO particles with molten aluminum. Differential Thermal Analysis, X-ray Diffraction and Scanning Electron Microscopy have been used to study the various reaction mechanisms and transformations. Al₂O₃ and Zn particles were identified in the particles extracted from the composites.

14:00

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Titanium/Advanced Material & Processes (WEDPM1)

Paper Start Time: 14:00

Paper No.: 5025

Paper Title: **Development of Advanced and Free-machining Titanium Alloys**

Zdenek Spotz, Slovak Academy of Sciences; Karel Saksl, Slovak Academy of Sciences; Carsten Siemers, Technische Universität Braunschweig; Judith Laukart, Technische Universität Braunschweig; Badya Zahra, Technische Universität Braunschweig; Joachim Roesler, Technische Universität Braunschweig;

The chip formation process of Ti 15V 3Al 3Cr 3Sn and Ti 6Al 4V has been studied in detail. To improve their machinability and grain stability during heat treatments at temperatures above beta-transus lanthanum has been added to distribute second-phase particles in the titanium matrix. Lanthanum is almost insoluble in alpha-titanium at room temperature. The microstructure of the modified alloys consists of titanium, lanthanum precipitates in Ti 6Al 4V and La₅Sn₃-precipitates in Ti 15V 3Al 3Cr 3Sn due to the presence of tin. Several benefiting effects are observed in the lanthanum-containing alloys. During machining, short-breaking chips develop. In addition, grain growth is hindered. The mechanical properties are only slightly reduced.

Paper Start Time: 14:50

Paper No.: 5130

Paper Title: **Computational Simulation of Molten Titanium-aluminium Metals and Alloys**

Anton Lopis; Mintek (CHPC); Quinn Gareth Reynolds, Mintek; Kabwika Bisaka, Mintek;

Mintek has produced 35-40% Ti-Al alloys in DC Arc Furnace campaigns, however, process difficulties encountered appear related to poor understanding of the alloys' physical properties. Making measurements at around 1500°C is often impractical or expensive - Atomistic Computational Modelling (Embedded Atom Method, EAM) is ideal for studying alloys, leading to process improvements (efficiency/reducing environmental impact). Physical properties predicted include density, enthalpy, thermal expansion and heat capacity. EAM showed Ti-rich alloys to be densest, most stable and highest melting agreeing with experimental findings of furnace campaigns. Furthermore, modelling suggests 22-48% Ti-Al alloys have stronger amorphous propensities than other Ti-Al alloys.

15:35

Room: Georgia B (Plaza-2nd Floor)

Stream: LIGHT METAL - ALUMINUM, MAGNESIUM, TITANIUM

Session: Titanium/Advanced Material & Processes (WEDPM2)

Paper Start Time: 15:35

Paper No.: 5208

Paper Title: **Aluminum Arch Bridge at Arvida (1950) - Fabrication Adaptation**

Hugh J. McQueen; Concordia University (MIE),

The pioneering Al alloy road bridge across Riviere Saguenay near Lac St. Jean has withstood full road service for over half a century. Novel design and fabrication came from experience of Dominion Bridge with Alcans understanding of strong aircraft alloys. An arch of 90 m span suited to the chasm overcame deflections three times and thermal expansion double those of steel. While the yield stress of age-hardened 2014 (26S) is similar to that of period bridge steels, strain hardening, failure strain and fatigue limit are lower. Extruded sections were employed in contrast to rolled ones. To avoid damage to age-hardened metal, flame cutting was replaced by more accurate band sawing and welding by hot riveting (2017, 17S) in the shop and by cold riveting (2036, 16S) in the field. For greater strength, truncated conical heads were cold forged from hot rolled bars; similar ones were produced by hydraulic presses in the shop whereas in the field, annular heads by pneumatic hammers with a projection that expanded the drilled shank. Rivet holes were drilled to avoid distortion around punched ones with precise field reaming to reduce clearances. All components had to be of Al alloys to avoid galvanic corrosion except at the footings for steel bolts embedded in the concrete.

Paper Start Time: 16:00

PRELIMINARY PROGRAM

Paper No.: 5063

Paper Title: **Wetting of Various Interfacial Reaction Products Formed During Al-B4C Composite Preparation by Aluminum**
Duygu Kocaefe, University of Quebec at Chicoutimi; Arunima Sarkar, University of Quebec at Chicoutimi; X-Grant Chen, University of Quebec at Chicoutimi;

Al-B4C composites are used in nuclear waste storage. However, interfacial reactions consume B4C and reduce the quality of the composite. In addition, B4C is not wetted well by aluminum. In order to overcome this problem, Ti or other alloying elements can be added to Al. These elements react with B4C and form a product layer around the B4C particles and protect particles from reacting further. For a good quality composite, this layer has to be wetted by Al. In this article, the results of the experimental study on the wettability of the possible reaction products in the form of ceramic powder by Al will be presented.

Paper Start Time: 16:25

Paper No.: 4767

Paper Title: **Lunar Xenolith**

Therese Schneck Frade; International Ordovician and Petroleum Services;

The opaque minerals observed in Lunar samples from Descartes site are Ti-chromite, ilmenite, traces of troilite and metallic FeNi(1). At 3.85 Ga years Nectaris basin and 3.9 Ga years Descartes sites the primordial crust consisted mainly of ferroan anorthosite and Mg-suite(2). In Apollo 16 samples Mn is indeed substituting for Mg on the basis of 32 oxygens(3). The increasing oxidation exsolution in Jacupiranga ilmenite (high Mg, Mn, Nb) is accompanied by increase in Nb and decrease in Fe³⁺ contents of the ilmenite(4). The phases of lunar Fra Mauro merrillite and terrestrial whitlockite differ in the presence of hydrogen(5). (1) P. Ramdohr, El Goresy and O. Medenbach (2) Stoffler, D., Bischoff, A., Borchardt, R., Burghele, A., Deutsch, A., Jessberger, E. K., Composition and evolution of the lunar crust in the Descartes highlands, Apollo 16 (3) Haggerty S.E. Apollo 14 (4) Jose C. Gaspar and Peter J Willie Ilmenite in the carbonatites from the Jacupiranga complex Brazil (5) John M. Hughes, Bradley L. Jolliff and Mickey E. Gunter Apollo 14 lunar mission: The first structure of merrillite from the Moon.