WEDNESDAY, AUGUST 24, 2005, A.M.

SESSION 36: INTERNATIONAL SYMPOSIUM ON LIGHT METALS

METAL MATRIX COMPOSITES, FOAMS AND SURFACE TECHNOLOGY
Sponsor(s): Light Metals Section, The Metallurgical Society of CIM
Room: Neilson 1
Chair(s): G. DUFOUR, Alcoa, Canada and
J. MASOUNAVE, École de technologie supérieure, Canada

PAPER 36.1—8:30
PERMEABILITY OF METAL FOAMS AND ITS DEPENDENCE ON MICROSTRUCTURE.
M. MEDRAJ, V. LOYA, Concordia University, Canada
E. BARIL, L.-P. LEFEBVRE and M. GAUTHIER, NRC – Industrial Material Institute, Canada

Metallic foams (MF) are relatively new materials with a combination of attractive properties (permeability, high surface area, thermal and chemical stability, etc.). They can be produced from different materials and can be manufactured using various processes. Due to their unique properties, they find applications in different sectors of engineering, such as energy absorption, filtration, heat dissipation, etc. For many applications, the permeability is an important parameter to characterize and optimize. Most of the recent literature on the subject studied the permeability in the low velocity range. The present study was carried out to have a better understanding of permeability for greater velocity ranges. An equipment was designed and built for this purpose. Pressure drop measurements were made across the thickness of open-cell nickel foams. Pore and window sizes were measured by image analysis on SEM micrographs. The experimental results are in relatively good agreement with the Hazen-Dupuit-Darcy model (R^2>98%). The permeability is affected by pore size, porosity and the normalized projected area of the connecting pores (i.e. windows).

PAPER 36.2—8:55
STIR CASTING PRODUCTION OF ALUMINIUM-SILICON CARBIDE PARTICLE COMPOSITES: IMPORTANCE OF ADEQUATE MIXING OF PARTICULATES AND MELT.
M. BOZORGTABAR, Islamic Azad University, Iran
M. MERATIAN, Ishafan University of Technology, Iran and
M. JAFARPOUR, Mobarakeh Steel Company, Iran

Metal Matrix Composites (MMC) have a ductile matrix containing ceramic particles. Due to their improved wear properties, Al–SiC composites have economical applications in many industrial uses where wear is a problem. One of the most serious difficulties in manufacturing Al-SiC composites is obtaining adequate 'wetting' of the particles by the melt. In this research work, a stir casting system was designed for the improved manufacturing Al-SiC composites. The effect of some production variables such as the addition of SiC particles to the aluminum melt on wettability, was also studied. The results showed that the manual addition of particles would not be successful in manufacturing and that a system of adding silicon carbide particles through controlled temperature, atmosphere and improved mixing was needed.

PAPER 36.3—9:20
EFFECT OF TITANIUM ON SOLIDIFICATION MICROSTRUCTURE OF AL-16%B_4C COMPOSITES.
Z. ZHANG, A. CHARETTE, R. GHOMASHCHI, Université du Québec à Chicoutimi, Canada and
X.-G. CHEN, Alcan International Ltd., Canada

Aluminum boron carbide particulate reinforced composites have found new applications in nuclear industry due to their special capability to capture neutrons. Recently, Alcan successfully developed a liquid metal mixing process to fabricate Al-B_4C metal matrix composite instead of powder metallurgical technology. In the process, titanium is added into the composites to control interactions between boron carbide particulates and aluminum matrix. To understand the effects of titanium on the composites, the solidification microstructure of Al-16%B_4C without or with titanium was examined by optical and electron microscopes. The results show that titanium can improve the uniformity of the particulate distribution within aluminum matrix if the titanium content in the composites is more than 0.5%. Furthermore, it is found that the layer with rich titanium on the surface of the particulates can limit the formation of AlB_2 type compounds, which may greatly deteriorate the fluidity of the composites. In addition, it is also found that the amount of the reaction products in the composites increases with the increase of holding time. However, the rate of the increase is mitigated by the increase of the content of titanium in the composites. Besides, a procedure was proposed and implemented for the evaluation of uniformity of particulate distribution within aluminum matrix.

PAPER 36.4—9:45

EFFECT OF WORKPIECE TEMPERATURE ON THE MACHINABILITY OF ALUMINA/ALUMINUM METAL MATRIX COMPOSITES.

A. SAIGAL and H. SHAND, Tufts University, U.S.A.

The effect of temperature on the cutting forces during machining of alumina reinforced aluminum composites was investigated. Aluminum 6061, 10% Al_2O_3 reinforced composite and 20% Al_2O_3 reinforced composite were tested. A 5/8-inch diameter high-speed steel end mill, a Micro 100 TiN coated single edge endmill cutter and a two-fluted solid carbide insert cutter were used for tooling. The results, in general, showed an increase in the cutting forces as the temperature of the material increased. From the raw data, there are temperatures ranges in which the force data did decrease but they were insignificant with regards to predicting a downward trend. A regression analysis was used to understand which variables had the greatest affect on the forces being generated. The correlation and regression analysis showed that at 600 rpm (velocity: HSS- 98.2 sfpm, Micro 100 cutter - 78.5 sfpm, solid carbide cutter - 192.4 sfpm) the tooling, the workpiece material, built up edge, and temperature were statistically significant factors in the test. Tooling was a significant variable in all testing. The smallest forces recorded during machining were generated with the solid carbide two-fluted endmill cutter. Visually, the solid carbide tooling produced a better surface finish during the testing which made it the tool of choice. In addition, the force data proved that as the cutting speeds were increased, the cutting forces decreased.

COFFEE BREAK—10:10-10:40

PAPER 36.5—10:40

MULTI LAYER DIFFUSION BONDING OF POLYCRYSTALLINE AL_2O_3 TO AL-SR AND AL-MG ALLOYS.

K. JANGHORBAN, Shiraz University, Iran and

Multilayered ceramic-metal composites were produced by solid state diffusion bonding of polycrystalline alumina and three Al alloys containing 1 to 2%Sr, 2% Mg and Mg + Si (5057 Al alloy). The multilayered structures were fabricated at 610°C under a compressive stress of 3 MPa for 2 hours in He-5%H atmosphere. The ceramic-metal interfaces were studied by SEM and TEM equipped with energy dispersive spectrometer (EDS). Addition of 1 wt % Sr to Al promoted good adhesion, without producing any interfacial products, while the Al-2%Sr was poor in this regard due to the presence of dispersed Al_4Sr which is an intrinsic phase in the Al-Sr phase system. The Al-2%Mg alloy produced a continuous film at the interface, which was characterized to be $MgAl_2O_4$. Al alloys containing Mg and Si (5057 commercial alloy) produced not only the spinel structure ($MgAl_2O_4$), but another phase rich in Mg and Si (close to Mg_2Si). These latter interfacial reaction products were not the intrinsic phases in Al-Mg alloys, and were reaction products at the Al_2O_3 –Al alloy interfaces.

PAPER 36.6—11:05

EFFECT OF CU AND NI ON THE DIMENSIONAL STABILITY OF ALUMINUM ALLOY USED TO INTERNAL COMBUSTION ENGINE AT ELAVATED TEMPERATURE.

M. TADAYONSAIDI, Azad University, Iran
N. VARAHRAM, Sharif University, Iran and
N. BAGHERSAIEE, Ministry of Jihad Agriculture, Iran

The effect of alloying elements on the mechanical properties &thermal expansion of 336 casting alloy- usually used as piston alloy—usually used as piston alloy—which has low thermal expansion &very good high–temperature mechanical properties and good wear resistance was investigated. The mechanical properties & thermal expansion characteristic of samples with different combination of alloying elements, which enhance to reduce the cost of products, have been studies. The results show remarkable increase in the mechanical properties with increasing the amount of Cu & Mg ,while are reduced with increasing amount of Ni. On the other hand ,the use of eutectic aluminum alloy –as 336 alloy-with higher percent of Cu & Mg and lower percent of Ni are recommended for industry ,due to economical viewpoint and satisfactory properties.