

TUESDAY, AUGUST 24, 2004, A.M.

SESSION 17: INTERNATIONAL SYMPOSIUM ON LIGHT METALS AND METAL MATRIX COMPOSITES

ALLOY TECHNOLOGY II

Sponsor: Light Metals Section, The Metallurgical Society of CIM

Room: 202

Chairmen: M. SAHOO, CANMET, Ottawa, Ontario, Canada, and
G. DUFOUR, Alcoa Primary Metals, Montreal, Québec, Canada

PAPER 17.1 — 8:30

AGING EFFECTS IN 319 ALLOYS.

N.R. ANDRADE-GONZALEZ, J.E. GRUZLESKI, McGill University, Montréal, Québec, Canada, and
F.H. SAMUEL, Université du Québec à Chicoutimi, Chicoutimi, Québec, Canada

The present work was performed on four alloys containing Al-6.2 wt pct Si-3.5 wt pct Cu, with magnesium in the range of 0.02-0.40 wt pct, and strontium in the range of 0-165 p.p.m. Tensile bars were cast in a permanent mold (ASTM B108-160) and heat treated at 495°C for 4 hours, followed by quenching in hot water. Two different artificial aging temperatures were applied at 180°C and 220°C for times from 0.5 h up to 8 h. Tests were conducted with the intent of determining how the mechanical properties of an aluminum-based 319 alloy are affected when aging time and temperatures are varied. In general, it is seen that the alloy does not exhibit the common peak-overaged aging condition due to the presence of several coexisting phases, indicating that they form through complex eutectic reactions late in solidification.

PAPER 17.2 — 8:55

SUBGRAIN SIZES AND MISORIENTATIONS IN HOT WORKED ALUMINIUM.

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The subgrain sizes and misorientations were determined by Orientation Image Microscopy (OIM) in Al deformed in torsion to equivalent strains between 0.2 and 4 over the ranges of 300-600°C and 0.1-4.s-1. The results were compared to substructures observed by transmission electron microscopy (TEM) and by scanning electron microscopy with back scattered electrons (SEM-EBS). The OIM gives clearer evidence of boundaries with high misorientation than TEM does but over estimates their frequency by missing boundaries less than 1. TEM more clearly reveals low angle arrays of widely spaced dislocations with the result of a finer subgrain size than those indicated by OIM or SEM-EBS. The evidence supports a mechanism combining warm dynamic recovery (DRV), deformation band formation (permanent high angle boundaries) and geometric

PAPER 17.3 — 9:20

EFFECTS OF STRONTIUM ON THE OXIDATION BEHAVIOUR OF ALUMINUM-MAGNESIUM ALLOYS.

O. OZDEMIR, J.E. GRUZLESKI and R.A.L. DREW, McGill University, Montréal, Québec, Canada

Magnesium additions to aluminum enhance strength and hardness, lowering density, and improving corrosion resistance. However, during melting and casting processes, significant amounts of magnesium are lost due to the selective oxidation. Preventing these losses would reduce the production cost and improve the quality of the final product. The effects of strontium additions on the oxidation behaviour of pure aluminum and aluminum-0.5 to 5% magnesium alloys will be investigated by monitoring sample weight gains with time with a thermogravimetric balance at 700, 750, and 800°C. Sample surfaces have been examined using Field Emission Gun Scanning Electron Microscope and x-ray diffraction techniques.

PAPER 17.4 — 9:45

ALLOYING ADJUSTMENTS IN 7XXX ALUMINUM ALLOYS FOR THICK FORGING APPLICATIONS.

S.-T. LIM, Agency for Defence Development, Republic of Korea

Commercial 7xxx aluminum alloy thick semiproducts often have microstructural inhomogeneities and concurrent poor mechanical properties due to less deformation during hot working and slower quench cooling. To improve them, alloying adjustments are made in the commercial 7175 and 7050 alloy for thick forging applications. The effects of adjusting the relative content of Zn, Mg and Cu on the evolutions of the coarse equilibrium phases, age hardening response and resultant mechanical properties are investigated. As a result, low melting point equilibrium phases (M,T,S) are evolved depending on the constitutional effect, primarily the change of Zn:Mg ratio, and cooling rate following solutionizing. The formation of the T- and S-phases is effectively controlled in the adjusted (dilute and high

Zn:Mg ratio) alloys. In the slow quench, the adjustments promote homogeneous precipitation and lead to higher mechanical properties than conventional alloys, which is uniquely applicable in thick 7xxx forgings.

PAPER 17.5 — 10:40

HOT ROLLING PROCESS VARIABLE EFFECT ON THE ANISOTROPY OF MECHANICAL PROPERTIES IN Ti-6Al-4V ALLOY.

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Rolling temperatures and cross rolling ratios were varied to investigate the effect of crystallographic texture of alpha-phase on the anisotropy of mechanical properties in Ti-6Al-4V alloy. Hot rolling has been carried out at various temperatures ranging from 800°C to 920°C during unidirectional or cross rolling. Cross rolling ratios were varied from 0.3 to 1.0 at 875°C. The anisotropy of mechanical properties obtained from tensile and V-notch charpy test was closely related to the crystallographic texture and its intensity corresponding to each rolling condition. Basal pole figure observations revealed that transverse texture components as well as the anisotropy of mechanical properties increased with the rolling temperature. Strong transverse textures were observed at 920°C in unidirectional rolling, while basal and transverse textures were observed at 800°C and 860°C. Considering the anisotropy increased with transverse texture components due to beta phase transformation, it is suggested that rolling temperature should be controlled between 800°C and 860°C. Increasing cross-rolling ratio above 0.5 has attained low anisotropic ratios below 20%. The anisotropic behavior of mechanical properties could be explained by the maximum intensity ratio of transverse part to basal part of a pole figure.

PAPER 17.6 — 11:05

INVESTIGATION OF WEAR MECHANISM IN HIGH SILICON CONTENT AL-SI ALLOYS FOR POWERTRAIN APPLICATIONS.

M. ELMADAGLI and A. ALPAS, University of Windsor, Windsor, Ontario, Canada

Wear mechanisms of two commercial aluminum alloys namely a spray formed and extruded Al-25%Si alloy, and a sand cast 390 Al alloy (18.5 % Si) that are known to be successful in cylinder bore technology have been studied to have a better understanding of the requirements for wear resistant aluminum alloy design. From durability point of view these alloys are known to be successful for engine bore applications. It is interesting to compare the wear mechanisms in these alloys because they have significantly different silicon content and microstructures, and were produced using different techniques. The wear tests were done using a block-on-ring configuration, in both air and argon atmospheres. In spite of the differences in silicon content and microstructure, the wear mechanisms were similar and consisted of formation and destruction of hard tribolayers that are either formed by either mechanical or chemical interactions on contact surfaces. The differences in the wear rates between the two alloys arose from the differences in the hardness of the worn surfaces, and the alloy's ability to sustain the tribolayers on the worn surfaces.