ARC Centre of Excellence
Design in Light Metals

THE UNIVERSITY OF QUEENSLAND
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MECHANICAL PROPERTIES OF HIGH PRESSURE DIE CAST MAGNESIUM-ALUMINIUM (Mg–Al) ALLOYS

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Aims & Objectives

- First principle understanding of the contribution to the strength of the alloys from intermetallics and solute
- Studies to analyse the skin effect and geometry effect
- Determination of controlling parameters of alloys ductility
- Development of structure-property relationships
- Characterizing and modelling of damage development

Materials & Methods

- Preparation of high pressure die cast Mg-Al alloys with aluminium 0.5 to 12 wt%
- Tensile testing ---- Strength and ductility
- Hardness (macro and micro) mapping ---- Skin effects
- Electron back scattered diffraction (EBSD) ---- Microstructural characterization
- Synchrotron tomography ---- Modelling of damage development through in-situ tensile testing

Preliminary Results

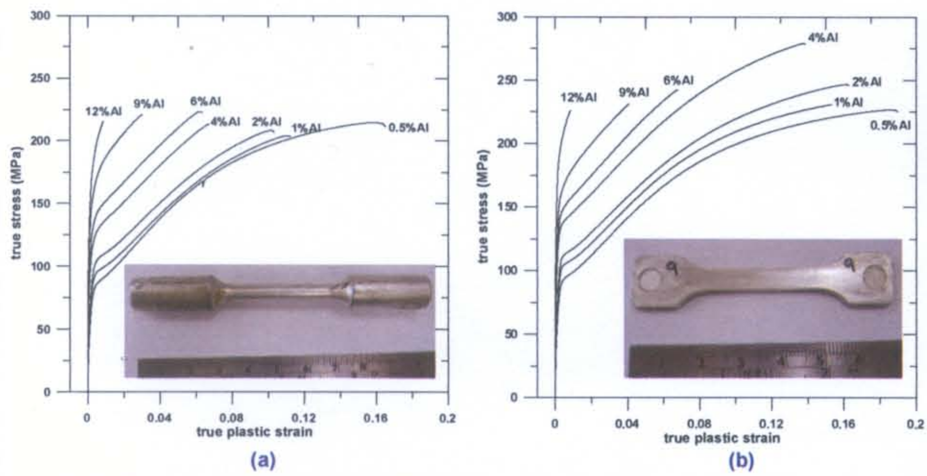

Fig. 1 True tensile flow curves of HPDC Mg-Al alloys (a) round and (b) flat samples.

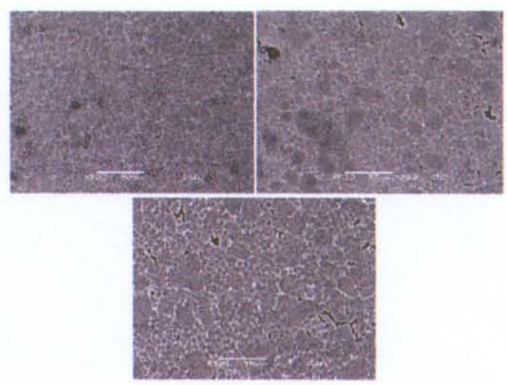

Fig. 2 BSE images of HPDC Mg-Al alloys, flat samples, with 2, 4, and 6% Al shows the transition of intermetallics formation with increase in Al content. The α-Mg and β - $Mg_{17}Al_{12}$ phases are indicated by dark and bright regions.

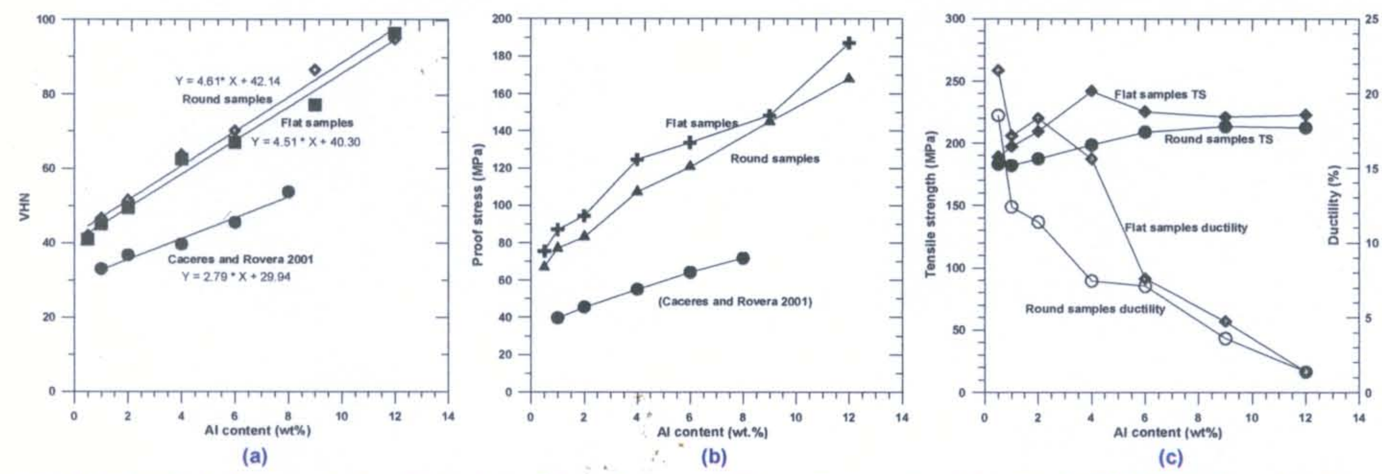

Fig. 3 Effect of aluminium content on (a) hardness, (b) proof stress, and (c) tensile strength and ductility of HPDC Mg-Al alloys. Data by Caceres and Rovera is included for comparison.

- VHN (fig.3a) and Proof stress (fig.3b) are increased in linear proportion with aluminium content in both HPDC and solution treated Mg-Al alloys.
- Increase in yield strength (fig. 3b) is observable with increase in aluminium content, irrespective the geometry of the sample.
- Large decrease in ductility (fig. 3c) at 2- 6% Al content is mainly due to transition in the structure of intermetallics as observable in fig. 2.
- Proof stress (fig. 3b) is higher in flat samples in comparison to round samples, where as the VHN (fig. 3a) is higher in round samples compared to flat samples. Further studies are under progress to resolve the discrepancy. This is likely to be connected with the proportion of skin.

Reference

C.H. Caceres, D. M. Rovera, Solid solution strengthening in concentrated Mg-Al alloys, Journal of Light Metals 1, 2001, 151-156.