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QUT

Solutions for Industry & the Environment
Case Study:
MECHANICAL BEHAVIOUR OF NANOSTRUCTURED MATERIALS AND MICROSYSTEMS

Cheng Yan
c2.yan@qut.edu.au
School of Engineering Systems
Faculty of Built Environment and Engineering
QUT, GPO Box 2434
Brisbane QLD 4001
P:+61 7 31386630
F: +61 7 3138 1516

Dr Yan is a senior Lecturer in materials and mechanical engineering in the School of Engineering Systems, QUT. Dr Yan has expertise in materials processing and characterisation, numerical analysis, failure and reliability of various structures.

Before joining QUT, he was an ARC Australian Research Fellow at Sydney University where he conducted extensive investigation on mechanical behaviour of nanostructured materials and microsystems. With the support of two ARC Discovery Projects and various other research grants, his ongoing research includes nano-crystalline alloys, polymer nano-composites and microelectronic and photonic packaging

He has generated more than 100 publications and maintained broad collaboration with CSIRO, CRC and many local and overseas universities. He serves as the committee member of Australia Fracture Group and conducted many consulting projects for local industry on composites, fatigue and fracture of various engineering structures.

Research - Nanostructured materials

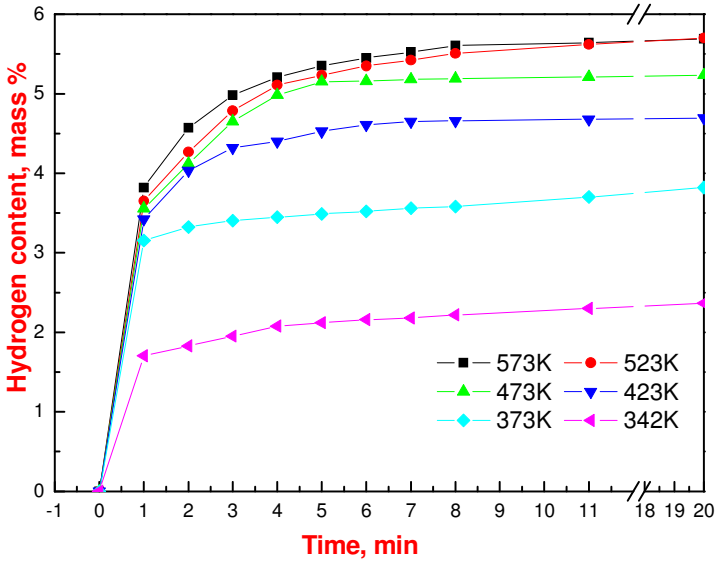
The ability to control the nanostructure of materials has opened up opportunities to create new materials with enhanced strength and new smart microsystems. Many new nanostructured materials and nanocomposites exhibit superior mechanical and physical properties compared to existing materials. New research at QUT is focussing on the mechanical behaviour of nanostructured materials and microsystems and on-going projects are focused on characterization of nanocrystalline materials for a wide range of applications, from hydrogen storage to fibre-optic devices.

Mg-based and $TiCr^2$ alloys for hydrogen storage

The development of materials capable of storing hydrogen at high densities is critical to the deployment of hydrogen as a transport fuel.

Light metal-based materials are considered as the most promising candidates for efficient hydrogen storage. Mg-based and TiCr2 nanostructured alloys have been developed with attention to improving hydrogenation kinetics and lowering the working temperature. High hydrogen storage capacity and excellent absorption/desorption properties have been achieved. The hydrogen absorption in the Mg-TiVCr alloy is about 5.7 and 3.8 wt.%, at 573 K and 373 K, respectively.

Hu, Y. Q., Yan, C., Zhang, H.F., Ye, L. and Hu, Z. Q. (2004) Preparation and Hydrogenation Characteristics of Mg-30%Ti37.5V25Cr37.5 Composite, Journal of Alloys and Compounds, 375, 265-269.



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Australian Nanotechnology Alliance Limited
A.C.N. 45 120 844 224

PO Box 609
Hamilton QLD 4007
(T) 07 3216 4717
(F) 07 3216 4017
(E) info@nanotechnology.org.au

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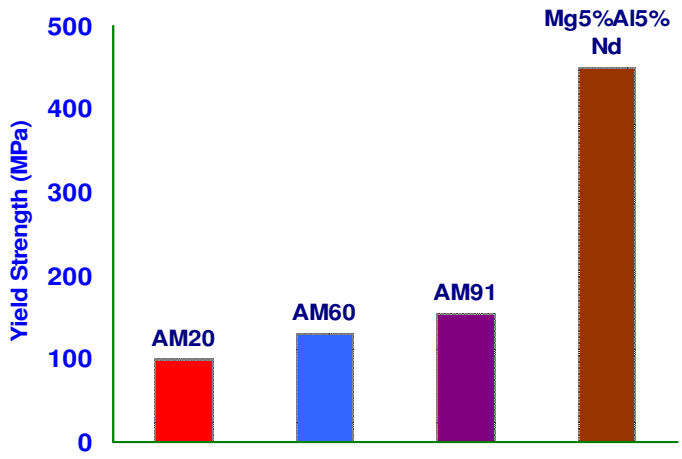
Characterisation of conventional and nanostructured light alloys

Recently, light alloys (Mg, Al and Ti) are attracting increasing attention for potential applications in automotive and aerospace industries. In collaboration with the National University of Singapore and CSIRO, current work is aimed at characterising deformation and failure mechanisms of conventional and nanocrystalline Mg-based alloys. Significant increase in yield strength has been observed in nanocrystalline Mg alloys, such as Mg-5%Al-5%Nd.

Yan, C., Ma, W., Burg, V. and M.W. Chen (2007) Experimental and numerical investigation on ductile-brittle fracture transition in a magnesium alloy, Journal of Materials Science, 42, 7702-7707.



Other Research

Thermal-mechanical behaviour of microsystems, addressing outstanding issues in the development of microelectronic, photonic, and MEMS technology;
Characterisation of Zr-base bulk metal glasses; and
Strength of polymer nanocomposites

Opportunities

We are seeking partners with specific needs for various engineering materials (polymers, ceramics and metals), materials properties evaluation, failure and reliability analysis, numerical simulation, design and development of microelectronic, photonic and MEMS devices.

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