

Roger Darlington/Lightweighting strategy, JLR-perspective

Weight reduction is the key to innovation in design, driven by commodity prices, CO2 restrictions, downsizing and hybridisation demands from the market place. The paper presented the use of post forming of heat treatable alloys for high energy absorption and high pressure die castings, in both Al and Mg, for crash resistance and stiffness. This was demonstrated in the new Range Rover which is 200Kg (40%) lighter than its steel predecessor. Joining technologies were also examined in view of hybridisation and ease of reuse and recycle targets to support a sustainable material supply chain.

Cheryll Pitt/Light Metals in the Defence Industry-Improving performance in severe environments

Military assets operate in extreme conditions both mechanically and environmentally. There is no choice of operating conditions, from polar to tropical environments and with loading, fatigue and strain rates at an order of magnitude above civil applications. Light alloys in defence have to meet cost, performance, supportability and safety demands. The presentation examined balancing all of these demands for aluminium, titanium and magnesium applications and the length of service, repair and overhaul implications.

Use of Titanium in landing gears

Messier-Bugatti-Dowty is a world leader in the supply of Landing Gear Systems with over 20,500 aircraft equipped from 33 airframe customers, 3,000 commercial/military operators and 90 military and commercial programs. The presentation looked into the factors influencing the move to use more titanium for twin aisle programmes (A350, B787) which will increase consumption by an order of magnitude and will approach the current usage of low-alloy steel by 2015. The business case is open for use of titanium on future single aisle programs (replacement of A320, B737) and the key parameters were discussed.

Kartik Rao/Low cost titanium

Titanium is a high value metal with annual volumes of ~170,000 tonnes in a market worth between \$5-10bn. The market for additive manufacturing is currently worth over \$1 billion and is growing at 20% CAGR and the market for powders is expected to grow to ~\$30 billion by 2025. Additive manufacturing grade Ti powder prices range from \$200-400/kg, high grade powder demand from the aerospace industry remains strong due to use of composites and the drive for fuel efficiency whilst industrial grade is used in the petrochemical, desalination and medical industries. The current market size is constrained by cost and could expand rapidly if these costs can be lowered. The presentation covered a simple, highly cost effective electrolysis process to produce a range of tailored Ti powders which could significantly reduce Ti processing costs by allowing AM near net shape production.

George Thompson/LATEST 2

The EPSRC LATEST2 Programme is aimed at providing the underpinning fundamental research required to facilitate a step change in high performance, light alloy and multi-material solutions in the transport sector leading to a reduction in energy consumption and CO2 emissions. The programme is carefully tailored to meet the needs of industry and will provide the supporting research needed to maintain global competitiveness in the realignment of manufacturing towards sustainable transport technologies.

Martin Jackson/Titanium overview

The presentation provided an overview of the main UK university Titanium research programmes from friction joining, near net shape AM to TiNi smart structure research at the University of Birmingham. These included: Micro-mechanisms of deformation at Imperial College, Ti characterisation to hyper joining of metals to composites at University of Manchester; powder forming and machining to FEM of solid state processes at Sheffield University and mechanical property assessment to diffusion bonding at Swansea University.

Arnas Fitzner/Review of PhD project: Effect of Aluminium on deformation mechanisms and ductility in Ti-alloys.

This LASTEST 2 project aims to improve formability, machinability and in service properties of Ti alloys with a fundamental approach to understand why CP-Ti twins profusely, but Ti6Al4V does not and to study the effect of specific alloying elements on deformation.

The presentation examined processing history on mechanical behaviour. EBSD microstructures, textures and nanoindentation were used in the characterisation of anisotropy relating hardness to crystal orientation and pre and post deformation.

John Morlidge/TSB strategy

With a budget of £440m the TSB is identifying and addressing problems restricting innovation. The key challenges are a) accelerating the journey between concept and commercialisation, b) connecting the innovation landscape, c) turning government action into business opportunity, d) investing in priority areas based on potential, e) continuously improving capability. The presentation explained the criteria to be met, the priority areas for advanced material technology and the enabling technologies required to drive innovation in UK research and industry.

Tristan Crawford, Single-aisle wing.

Airbus is planning development of a single aisle aircraft over a six-year period with a requirement to produce between 40 and 60 aircraft per month. Some of the issues which need to be addressed are: tougher environmental requirements; an ability to reduce weight of wings by 25%; use of enhanced manufacturing techniques; can maintenance costs be reduced? The presentation explained the likely benefits which will arise from increased use of aluminium throughout the aircraft, allowing use of improved toughness alloys, adoption of near net shape manufacturing techniques, higher recycling rates and simpler repair procedures.

Matt Thomas/Titanium

TIMET was founded in 1950. 75-80% of titanium produced goes into the aerospace sector, with the majority in the UK going to Rolls-Royce. Aircraft company predictions indicate a requirement for over 1m tonnes of titanium over next 20 years primarily for engines and some body parts. The presenter recognised the importance of building strong academic links with a number of key UK universities. It is easier to justify industrial support for applied projects rather than more pure research topics.

Tim Wilks, New Markets for Magnesium

Increased use of magnesium is anticipated in the automotive, healthcare and aerospace sectors over next ten years. In the automotive sector, die casting growth at 6-8% per year is driven by weight reductions and CO₂ emissions. For healthcare, trials are ongoing to assess magnesium alloys used as bio-absorbable repair implants. It is expected that aircraft regulations will be amended so that

magnesium alloys can be used for interior applications such as seating. Galvanic corrosion remains a key issue that restricts use of magnesium alloys.

Geoff Scamans/Aluminium research for road transport applications

Jaguar Land Rover has built on aluminium technology first developed by Alcan in early 1980s. Aluminium sheet production (predominantly 6000 and 5000 series alloys) in the EU reached 200,000 tonnes in 2012 and continues to rise swiftly. Similar trends expected in USA. Rapid growth in use of extruded products (up to 15%) also expected. TSB is providing £50m of funding to support approximately 20 projects in the aluminium/magnesium area concentrating on resource efficiency and low cost vehicles. Major EPSRC support for light metals research is concentrated on doctoral training centres and major centres such as Manchester (LATEST2) and Brunel (LiME). There is growing long-term emphasis on closed loop recycling.

Joe Robson/Magnesium research

Significant opportunity has been identified for magnesium in transport applications as 33% lighter than aluminium. Key areas of research include reducing anisotropy in sheet applications, manufacture/fabrication of complex shapes, similar and dissimilar metal joining and corrosion control. Magnesium research only receives 5% of light metals funding from EPSRC. There are a small number of part-time academics but well-respected both nationally and globally. Industry support from Magnesium Elektron is greatly appreciated.

Fan/BCAST Research

Outlined development of LiME (Liquid Metal Engineering) at Brunel University (in collaboration with Birmingham and Oxford), which covers fundamental research and technology development through to industrial application. Expanded support from EPSRC (£3.9m), JLR (£3m) and Constellium (£2.5m) for the creation of a national scale-up facility for automotive light metals research. Brunel University is putting in a dedicated building, facilities and other support. Plan is to expand work on shape castings and also to move into the pilot scale fabrication of wrought products.

Mark Jolly/Sustainability

The presentation defined sustainability in the context of resource demand and criticality and reviewed the energy of materials processing. There is a triple bottom line to be gained from Environmental, Economic and Social sustainability awareness. For aluminium the sector use and energy consumptions were examined in comparison to 5 key materials to compare CO2 emissions and energy intensive manufacturing costs required to create a circular economy.

Andrew Lawrence/EPSRC strategy

The presentation gave an overview of UK government funding over the innovation landscape from discovery/initiation to deployment and exploitation. EPSRC funding focuses on discovery and adaptation/integration and directs policy to shape capability, delivery and impact through the development of leaders. The delivery plan for 2011-2015 has a budget for the research infrastructure. Metals research is included within materials engineering research with a £89m portfolio. Key EPSRC investment in light metals include the LiME and TARF-LCV projects at Brunel, LATEST 2 at Manchester, Heterogeneous Mechanics at Imperial, AMCC at Brunel and Multifunctional high performance alloys at Oxford.