Titanium Strategic Review

Outline of findings

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Overview

- UK Capabilities
- Specific Research and Development needs
- New and Innovative Technologies
- Competitive Materials
- New Market Opportunities
- Recommendations
UK Capabilities

- Primary Reduction
- Remelting & Ingot Casting
- Conversion
- Forming
- Fabrication
- Surface Engineering
- OEM
R&D Needs

• Industry Needs Driven by Cost Reduction
  – Additive Manufacturing (not subtractive)
• Alloy Performance Appropriate for Application
• Surface Engineering
• Modelling and Simulation
  – Process
  – Performance
Modelling Need

• Process
  – Casting, Forming, Machining, Welding, Powder Route

• Microstructural Development
  – Phase, texture, grain size, distribution

• Performance
  – Corrosion, Structural Integrity

• Life Cycle Cost Analysis
Development Need

• Validation of Modelling

• Near Net Shape Methods
  – Powder Production, Consolidation and Processing
  – Thin Wall and Precision Casting

• High Speed / High Precision Machining

• Design Codes for Structural / Semi-Structural
  – Construction, Corrosion Resistant Service
New Technologies

• Powder Processes
  – HIP, CIP, MIM, Shaped Metal Deposition
  – Plasma Spark Sintering
  – Powder Forging
New Technologies

- Coating Technologies
  - Wear and Thermal Resistance
- Low Heat Input Joining Processes
- Processing of Shape Memory Alloys
Competitive Technologies

• Based on Selection for Performance
  – Not typically for “Fashionable” reasons
  – Corrosion Resistance
  – Mechanical Performance & Light Weighting
Corrosion Resistant Service

Stainless Steels

Nickel Based Alloys

Cobalt Alloys (Stellites)

NiCrMo alloys (Prosthetics)

Zirconium Alloys (emerging)

Epoxy polymers (to elevated, not high, temperatures)
Light Weighting

- Mechanical Performance / Light Weighting
  - In Some Aerospace Applications Ti is Not Considered Replaceable

- Decisions Based on $ per Kilo and Availability
  - Aluminium
  - Magnesium
  - Ultra High Strength Steel
  - Polymer Matrix Composites
    - Aramid Fibre
    - Carbon Fibre
New Market Opportunities

• Most Opportunities are Increases in Current Market
New Market Opportunities

• Increasing “Dilettante” Use
New Market Opportunities

Aerospace

• Increased Proportion of Ti Used in Civilian and Military Aircraft

• Increased Aircraft Numbers and Flight Miles
Defence

• New Defence Projects
Corrosion Resistance for Sea Water Applications

Image Courtesy of Marine Current Turbines Ltd
Recommendations

• Research needs to be focused on the industry needs highlighted
• Increased scope of design cases and guides
• Investment is required to address capacity gaps
• Improved Communication between:
  – Knowledge base
  – Knowledge base and industry
  – Supply chain
  – Funding Agencies (DTI, EPRSC, RDA, etc)