Challenges of Joining Dissimilar Light-Weight Materials for Automotive Applications
Road Map for transport

$\text{CO}_2$ emissions $\Rightarrow 95 \text{ g/km}$ by 2020
Introduction

Reasons for Lightweight Design

Driving Resistances

- **Power demand**

\[
P = (e_i \cdot m_F + m_{zu}) \cdot a \cdot v + (m_F + m_{zu}) \cdot g \cdot \sin(\alpha_{St}) \cdot v + (m_F + m_{zu}) \cdot g \cdot \cos(\alpha_{St}) \cdot f_{R} \cdot v + 0.5 \cdot \rho_L \cdot c_w \cdot A \cdot (v - v_{w})^2 \cdot v
\]

- **Influencing factors**
  - Weight: 100 kg $\sim$ 4.7 g CO$_2$/km
  - Aerodynamic: 0.1 m$^2$ $\sim$ 3.5 g CO$_2$/km
  - Mechanics (motor): 100 W $\sim$ 2.1 g CO$_2$/km
  - Tires: 1 % $\sim$ 2 g CO$_2$/km
  - Electrics (generator): 100 W $\sim$ 2.6 g CO$_2$/km
Introduction – Industrial trends

- Increasing use of Light Alloys Al, Mg, Ti
  - More difficult to join
- Increasing use of Composites
- Increasing use of modelling tools in design
- Multi-material designs

- New drive trains
  - electric
  - hybrid etc
- More efficient complex component geometries
- Lower environmental impact sustainable manufacturing
- Cost effective manufacturing
- End of life recycling
- Higher performance Materials
  (Composites, boron steels, Al, Ti, Mg)
Multi-Material Designs

Weight Saving > 40%

e.g. EC - Superlight Car Project (SCP)

Institute for Automotive Engineering (IKA) of RWTH Aachen University

Challenges in -
Welding technology
Materials engineering
Challenges of Joining Dissimilar Light Weight Materials for Automotive Applications
Session A
10.30 Joining of lightweight materials for transport applications - Dr Ian Norris, TWI Ltd
11.00 Application of Ultrasonic Metal Welding for Joining Dissimilar Materials – Dr Frank Balle, Institute of Material Science and Engineering, Uni Kaiserslautern
11.30 Durability testing of riveted, bonded and hybrid aluminium joints for automotive body structures – Dr Paul Briskham, The University of Coventry
12.00 CAE Design of Automotive Body Structures for Joining – Andrew Blows, Jaguar Land Rover

12:30 LUNCH

Session B
13.30 Metallurgical challenges in joining lightweight dissimilar materials -Phil Prangnell, University of Manchester
14.00 LORTEK-IK4 Perspective - Alberto Echeverria Zubiria, Lortek
14.30 Recent developments in fusion processing of aluminium alloys weld metal engineering, joining to steel and large scale additive manufacture - Professor Steward Williams, Cranfield University
15.00 Remote Laser Welding of AA6xxx Fusion-TM Material - Cyrille Bezencon, Novelis

15:30 AFTERNOON BREAK

Session C
16.00 Advanced friction joining processes - Dr Jorge Dos Santos, GKSS Germany
16.30 Joining lightweight automotive structures: Warwick Manufacturing Group perspective - Mr Richard Hewitt, Warwick
17.00 Surface Engineering Challenges of dissimilar material joints - Dr Michele Curioni, University of Manchester.

DISCUSSION WORKSHOP