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- **Background:** MPhys, Physics with Astrophysics
  University of Sheffield, 2010

- **Eng.D topic: Friction Stir Welding of Titanium Alloys**

One of the main obstacles of Friction Stir Welding (FSW) titanium alloys is the development of a tool material that can withstand the high temperatures (≥1000°C) and stresses associated with the process, whilst being inert with the highly reactive titanium workpiece during the high temperature thero-mechanical deformation.

In this study a number of tools of different materials have been used to join 8 mm thick Ti-6Al-4V sheets. The microstructure, mechanical properties and the development of residual stress were characterised using electron microscopy, tensile and hardness testing and neutron diffraction to understand the influence of the process parameters and of the tool. It has been found that the microstructure of the weld region displays either acicular α or martensitic α', which was attributed to the localised thermal fields associated with the FSW tool and the subsequent rapid cooling. Volumetric features (e.g. wormholes and kissing bonds) as well as tool debris were occasionally observed in some of the welds, resulting in a reduction in mechanical properties. The process parameters play an important role in the welding process, whereby the tool performance can be enhanced through the use of appropriate parameters.

- **Experimental Techniques/Equipment:**
  - SEM, Neutron and X-ray diffraction, Mechanical testing