

Status and challenges of dissimilar metal welding

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A review of the status and current challenges of dissimilar metal welding is proposed. By dissimilar metal welding we mean the welding between metals of different primary chemical nature. The FSW scientific research community has been highly focussed on dissimilar metal welding in the past years as lightweighting is a major concern for the transportation (e.g. welding Al to steel, Al to Ti, Al to Mg, etc...) and electrical energy (e.g. welding Cu to Al) industry. Placing the right material at the right place often also imposes to solve the issue of dissimilar welding. Friction stir welding has the potential to help but major challenges need to be solved. The following will be discussed with examples from Al+steel, Mg+steel, Al+Cu, Al+Mg, Ti+steel and Al+Ti systems on both butt and lap welds:

- A generally brittle intermetallic compounds is formed at the interface between the two material. Its thickness can be controlled by the processing parameters, but the consequences on the mechanical properties still need understanding. An overview of the various intermetallics formed as a function of the couple of materials is presented and the effect of the welding parameters on their thickness is discussed.
- Material mixing has consequences on the welding defects and on the formation of intermetallic phases.
- The material position (advancing or retreating side), the offset of the tool and the welding parameters (advancing and rotational) speeds influences the mechanical properties, and in particular the weld tensile strength. Some general trends in the welding conditions leading to the best performances will be evidenced for the various material couples.
- Hints of constitutional liquation have also been reported, in particular in Al+Mg welds. The consequences on the weld performances will be highlighted.
- Some possible process modifications compared to classical FSW will be addressed and their potential for solving issues reported.