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Industrial Member Report Summary – Key Findings for Industry

Spatter Reduction when Welding Carbon Steel and a 5xxx Series Aluminium Alloy with a High Brightness Fibre-Delivered Laser Beam

TWI Core Research Programme

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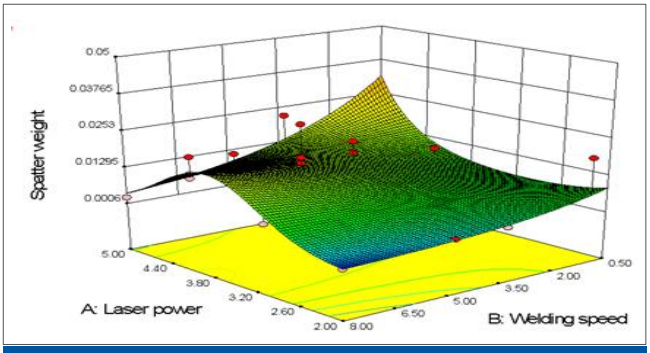
Introduction

It is known that high brightness, 1µm wavelength lasers (ie fibre and disc) may result in high, and potentially unacceptable, levels of weld spatter compared with CO_2 and Nd:YAG lasers. In this project, the effects of process parameters on spatter formation have been studied, using statistical techniques, for carbon steels and a 5xxx series aluminium alloy. In addition, high speed imaging and numerical modelling have been used to better understand the mechanisms of spatter formation.

Industrial Challenge

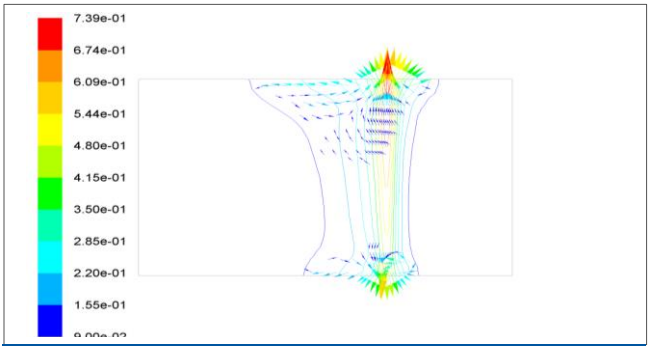
Despite the effect of spatter on surface appearance, and resulting fit-up issues for subsequent assembly operations, the loss of material through weld spatter and the associated instability in the process may also result in other imperfections/defects; including, underfill, undercut, and porosity. Depending upon the application, the weld spatter may either be accepted, mechanically removed, or, in more extreme scenarios, result in the welded part being scrapped. Consequently, there is an industrial need, for current and future adopters of high brightness laser welding, to understand spatter formation mechanism(s) and use appropriate measures/procedures to reduce/eliminate spatter.



Response surface plot, detailing the effects of laser power and welding speed on spatter weight when welding AA5083 aluminium alloy plate

Key Findings

- Recommendations for reducing spatter when laser welding carbon steel and a 5xxx series aluminium alloy have been developed
- The CFD model has been a useful tool in understanding spatter formation mechanisms and explaining influences of welding parameters on spatter behaviour.
- The statistically analysed experimental trials, high speed imaging and numerical modelling have enabled four potential spatter formation mechanisms, when welding with high brightness lasers, to be identified.



Modelled velocity fields (arrows) and weld pool profiles (isotherms) when laser welding AA5083 aluminium alloy plate

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