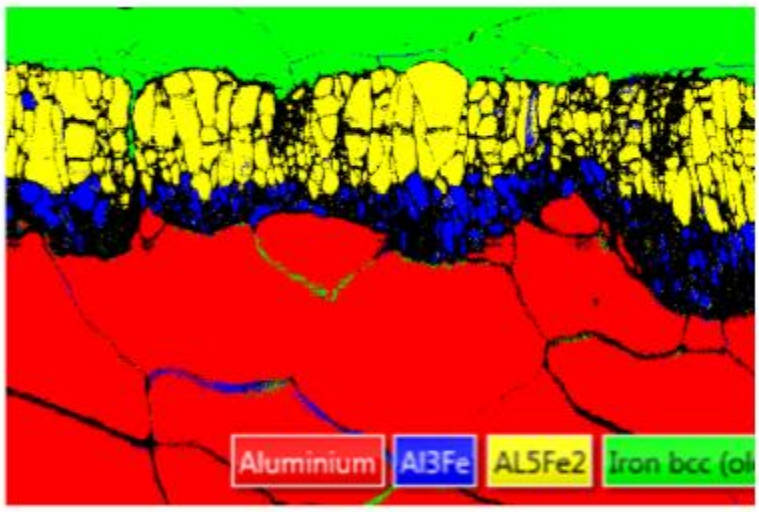
Solid state additive manufacturing of aluminium alloys on steel employing Friction Surface Cladding
the formation of intermetallic components

In many marine applications there is a need to structurally bond aluminium superstructures to a steel hull. Currently, dedicated aluminium-steel pieces are employed that are manufactured by (vacuum) explosion bonding leading to relatively high costs and restrictions in design. Exploratory work on Friction Surface Cladding (FSC) has shown that the deposition of commercially pure aluminium on steel is possible. Hence, similar aluminium-steel pieces could be manufacturing as currently in use in marine applications, but with a larger design freedom.

Al layer deposited on top of steel



Formation of intermetallics (blue, yellow) at Al/steel interface

A recent first study indicated that under certain process conditions undesirable intermetallic components are formed at the steel-aluminium interface. A diffusion type of model was composed to model the intermetallic growth behavior at the interface. Although the model gives a reasonable description for the observed phenomena, it does not give sufficient understanding of the formation process at the early stages of the deposition process. A more thorough understanding of the important conditions for interface bonding and the role of diffusion processes at the steel-aluminium interface is required to better design the deposition process.

Objectives

The objective of the research project is to characterize the deposition process of aluminium onto steel and the formation of intermetallic components. The following aspects should be included:

(i) Perform a thorough literature study to the interface bonding and the role of diffusion in the solid state bonding processes of aluminium to steel.
(ii) Characterize the microstructure and bond strength of deposited layers. Use (if possible) testing procedures proposed from literature.
(iii) Establish (model based) relations between the bond strength, the process conditions and the microstructure. Take the formation process of intermetallic layer(s) at the aluminium-steel interface into account.

Contact: More information: contact Ton Bor (t.c.bor@utwente.nl) 2453 (N203)