PhD Grants from the China Scholarship Council: Co-operation Program with the UTs and INSAs (France), Program 2022

Thesis subject :

Optimizing weld properties and processing conditions of magnetic pulse welding

Keywords :

Magnetic pulse welding, Welded joint properties, characterization, modelling, optimization

Description :

Joining dissimilar metals with different thermal properties using traditional fusion welding processes remains a challenging task. Magnetic pulse welding (MPW) is a solid state process that enables to join dissimilar metals using high speed impact without creating a weld pool. MPW involves multiphysics phenomena under fast dynamic conditions that affect the materials microstructure and the joint properties. To date, significant achievements were carried out in terms of reliability, flexibility, cost efficiency and environmental friendliness of this innovative process and a great deal of research was undertaken to understand the interface dynamics and formation during impact welding and especially the intermediate layer metallurgy [1-4] (transition zone between the two materials). Due to the high strain rate, the plastic dissipation and the complex thermal history, the intermediate layer exhibits complex composition, morphology and microstructure with intermetallic compounds as illustrated in figure 1.

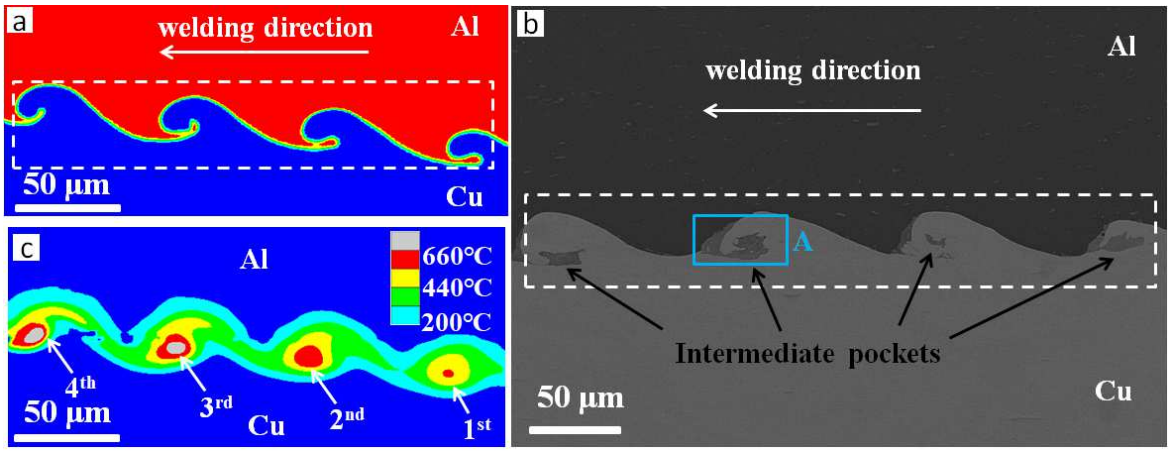

Figure 1. (a) Numerical prediction of interface morphology (b) SEM image of the interface (c) local temperature map

Linking the interface morphology/microstructure to the bonding strength and the joint bearing capacity is still an open issue. This is the major objective of this PhD subject which will investigate the relation between the process parameters and the multi-physics and transient response of the interface during the high strain collision. The overall objective is

to build a weldabilty window based on solid physical foundations. The PhD candidate will establish material/process interactions governing the MPW behavior in order to predict and specify the weldability conditions for various metals combinations. The numerical simulation will be performed with Abaqus and LS-Dyna software.

Expected background of the PhD candidate :

Material science, Mechanics of materials, Dynamic of structure, Finite element computation, Heat transfer

Supervision of the research works :

Supervisor: M. Rachik

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