Laser Assisted Brazing of Titanium to Aluminum Alloy

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Abstract

Laser assisted brazing with Al-Si fillers in V-shaped groove configuration is a perspective method for joining of aluminum alloys to titanium. The quality of brazed interface is determined by Ti diffusion distance in the melted zone that becomes, after the solidification, a compact layer of Al-Ti-Si phases. Typical defect of this type of assemblies resides in lack of brazing at the bottom of the groove that becomes even more pronounced when thickness of materials overpasses 2 mm.

The present work introduces multiscale model that allows estimating diffusion process at titanium/melted zone interface in function of thermal history of welded plates. 3D model of heat transfer with moving laser source and fixed geometry is linked to 2D model of cross section of the groove where Fick equation is solved basing on the thermal history of a slice.

Comparison of maximal temperatures attained by the groove and Ti diffusion distances allowed concluding that for efficient brazing Ti side of the groove must attain 1200 K. Model allows estimating the effect of thermal field on diffusion distance of Ti in the melted zone and thus predicting the fraction of brazed surface of chamfer. Associated parametric studies help to understand the effect of joint geometry and heat source parameters on brazing efficiency and propose optimized operational condition.

Figures used in the abstract

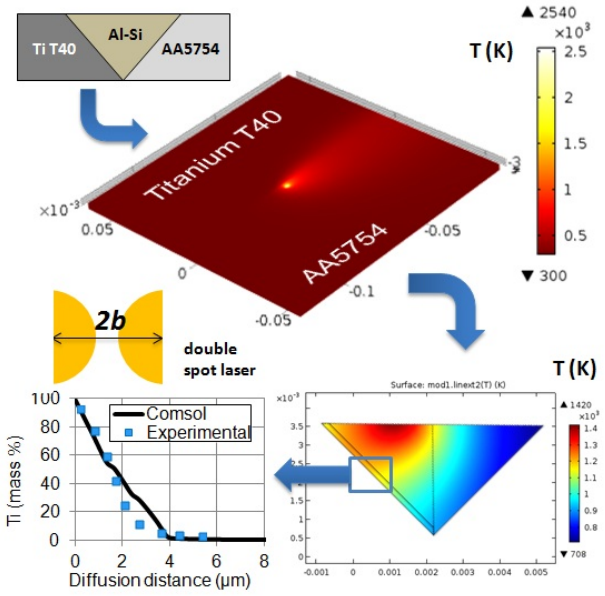

Figure 1: Multiscale model of heat transfer and diffusion process at Ti/melted zone interface

Figure 2

Figure 3

Figure 4