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Prediction of intermetallic phase layer thickness in laser assisted hybrid friction stir welding of aluminium to steel

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Hybrid friction stir welding (HFSW) is an advanced solid-state welding process that can produce sound joint in between dissimilar materials possess different thermo-physical properties such as aluminium and steel. The crucial problem in joining of aluminium to steel is the low solubility of aluminium in iron leads to form brittle intermetallic phase layer. The existence of intermetallic phase layer is desirable for suitable joint quality; however, excessive growth of the phase layer deteriorate the joint strength. Conventional friction stir welding successfully joins aluminium to steel with controlling the growth of phase layer thickness, however, excessive tool wear and forming defects are the significant limitations of this process. These drawbacks may be overcome in HFSW process by introducing an additional heat source to pre-heat the harder material like steel and at the same time placing the tool in an optimal location for sufficient material flow around the tool. In the published literature, little efforts are available to understand the influence of joining conditions on growth of the phase layer thickness in hybrid friction stir welding of aluminium to steel. In the present study, an attempt is undertaken to estimate the growth of the intermetallic phase layer in laser-assisted hybrid friction stir butt welding of 2.5 mm thick AA5052 alloy to 1.4 mm thick ultrahigh strength steel DP590 through numerical analysis. A 3-dimensional conduction heat transfer based model using finite element method is developed to simulate the HFSW process. The estimated thermal cycles and peak temperatures at the joint interface from the numerical model are used to estimate the phase layer thickness. Further, the impact of the distance between the tool and laser on the growth of layer thickness is studied.

Recent Publications:

1. Bang HS, Bang HS, Jeong GH, Oh IH, Ro CS (2012) Gas tungsten arc welding assisted hybrid friction stir welding of dissimilar materials Al6061-T6 aluminum alloy and STS304 stainless steel. Materials and Design 37:48-55.
2. Bang HS, Bang HS, Song HJ, Joo SM (2013) Joint properties of dissimilar Al6061-T6 aluminum alloy/Ti–6%Al–4%V titanium alloy by gas tungsten arc welding assisted hybrid friction stir welding. Materials and Design 51:544-551.
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4. Bang HS, Bang HS, Kim YC, Joo SM (2010) Analysis of residual stress on AH32 butt joint by hybrid CO2 laser-GMA welding. Computational Materials Science 49:217-221.
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Biography

Hee Seon Bang is working as a chair professor in Welding and Joining Science Engineering department at Chosun University. Her main research interest area in the area of joining science and technology, conventional and hybrid friction stir welding, laser beam processing and process modelling.

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