Simulation of Interface Material and Joint Design for Enhancement of Weldability Between Dissimilar Materials: 405 Ferritic Stainless Steel and 750 Zirconium Alloy using Friction Welding Process

K. Koudinya
P. G. Student, M. Tech (AMS), Roll No. 1011P0305, Department of Mechanical Engineering, JNTUH College of Engineering, Hyderabad.

Under the Guidance of Dr. A. Chennakesava Reddy, Professor, JNT University Hyderabad

ABSTRACT

In the developing of new technologies, the use of joints between dissimilar materials has considerably increased [1]. In continuous drive friction welding, one of the workpieces is attached to a motor driven unit while the other is restrained from rotation as showed in figure 1a. The motor driven workpiece is rotated at a predetermined constant speed. The workpieces to be welded are forced together and then a friction force is applied as shown in figure 1b. Heat is generated because of friction between the welding surfaces. This is continued for a predetermined time as showed in figure 1c. The rotating workpiece is halted by the application of a braking force. The friction force is preserved or increased for a predetermined time after the rotation is ceased (figure 1d).

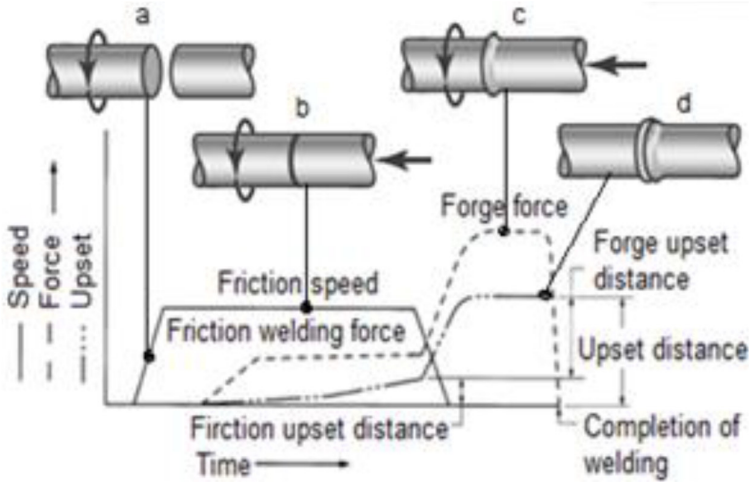

Figure 1: Friction welding.

The current work was proposed to investigate the weldability of friction welding process for dissimilar materials: 705 Zr-alloy and 405 ferritic stainless steel (FSS) with interface material between them using finite element method approach. Theses materials were welded wit or without interface material.

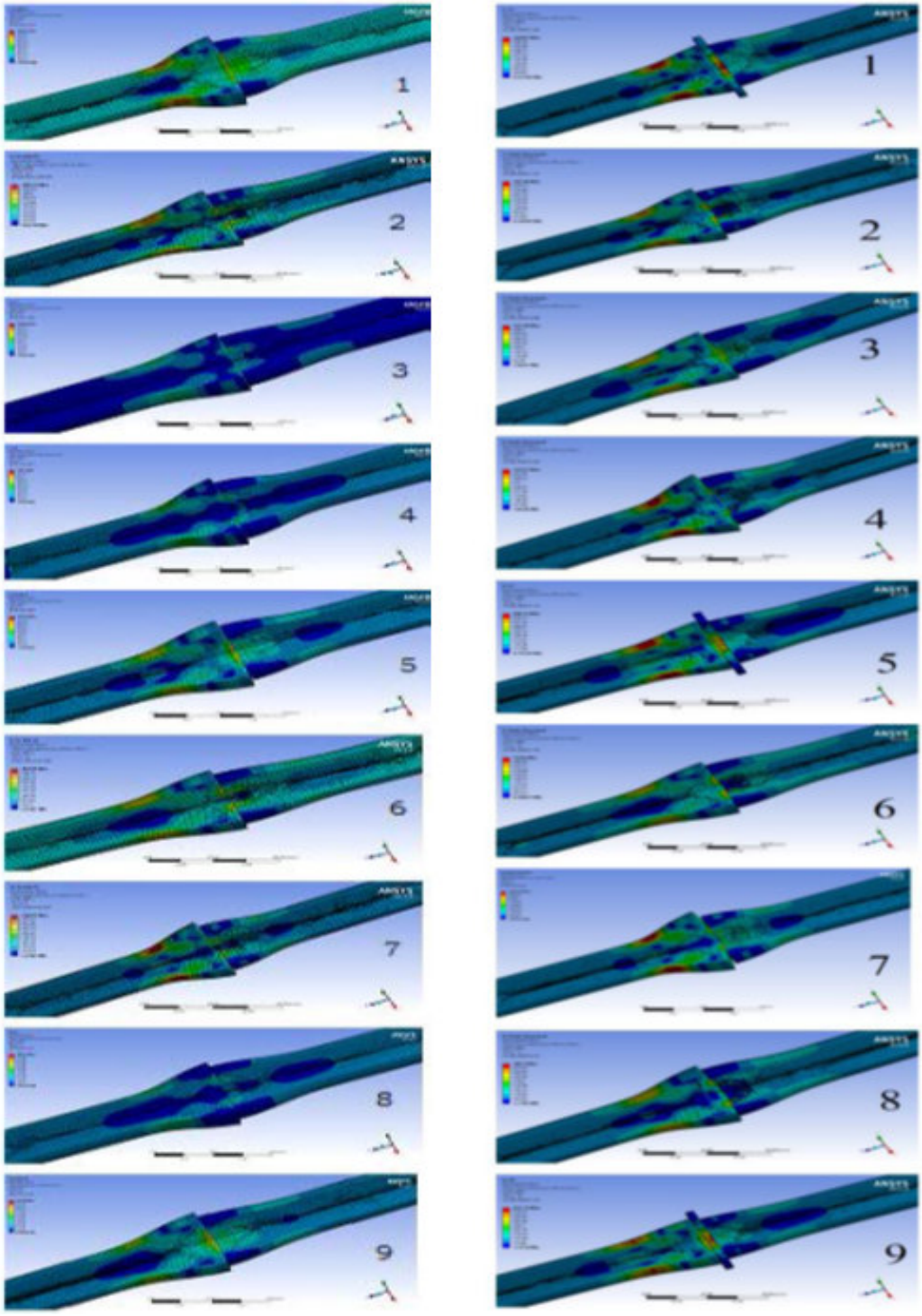

Figure 2: von Mises Stresses in the welded joints (a) without and (b) interface material.

This study shows that the weldability of 705 Zr alloy and 405 ferritic stainless steel is highly dependent on the rotational speed, frictional time and the type of joint. The stresses induced in the vee joint was very high, it is recommended to relieve them using appropriate heat treatment process as the quality of this joint is good. This is because of mechanical interlocking in vee joint and equal bulk deformation with other joints.

This study shows that the weldability of 705 Zr alloy and 405 ferritic stainless steel is highly enhanced by introducing an interface material which is compatible to both the alloys. The stresses induced in the plain joint was higher than vee and square joints. The vee joint imparts good strength at the joint because of mechanical interlocking and equal bulk deformation.

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