Application of Friction Stir Hole Clinching to Joining of Dissimilar Materials

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In recent year, multi-materials such as CFRP/Aluminum and CFRP/High strength steel are extensively used for the lightweight vehicle in automotive components. Thus, an efficient and appropriate joining method is required to combine automotive components with dissimilar materials. Generally, mechanical joining (self-piercing rivet, mechanical clinching, hole clinching) and adhesive bonding are used for joining dissimilar materials. However, it is difficult to join dissimilar materials using conventional joining methods due to different mechanical and thermal properties. The objective of this study is to propose a friction stir hole clinching (FSHC) process for joining Al6061 and DP980 sheet. The concept of this process is stir heating Al6061 sheet and then forming it into a mechanical interlocking joint with the DP980 sheet. In order to design FSHC process, a three-dimensional FE-model was constructed in ABAQUS/Explicit using the arbitrary Lagrangian-Eulerian (ALE) formulation. The FE-results for the undercut size and temperature distribution were compared with experimental data. Moreover, the effects of process parameters on joint strength were investigated by the pull-out test. Process parameters considered in this study were tool rotation speed, tool plunge speed, tool penetration depth and die depth. Finally, joint strength of FSHC was compared with that of hole clinching process. As a result, it was shown that the FSHC process was useful for joining dissimilar materials.

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