Multiple Crack Growth Prediction in AA2024-T3 Friction Stir Welded Joints, Including Manufacturing Effects

A great deal of attention is currently paid by several industries toward the friction stir welding process to realize lightweight structures. Within this aim, the realistic prediction of fatigue behavior of welded assemblies is a key factor. In this work an integrated finite element method - dual boundary element method (FEM-DBEM) procedure, coupling the welding process simulation to the subsequent crack growth assessment, is proposed and applied to simulate multiple crack propagation, with allowance for manufacturing effects. The friction stir butt welding process of the precipitation hardened AA2024-T3 alloy was simulated using a thermo-mechanical FEM model to predict the process induced residual stress field and material softening. The computed stress field was transferred to a DBEM environment and superimposed to the stress field produced by a remote fatigue traction load applied on a notched specimen. The whole procedure was finally tested comparing simulation outcomes with experimental data. The good agreement obtained highlights the predictive capability of the method. The influence of the residual stress distribution on crack growth and the mutual interaction between propagating cracks were analyzed as well.

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