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Three-dimensional simulation of 304L steel TIG welding process: contribution of the thermal flux

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Abstract: In this study, we focus on the determination of the heat transfer properties in Tungsten-Inert-Gas welding (TIG) problem combining an experimental and a three-dimensional simulation approaches. Optimal conditions are used to weld stainless steel (304L) sheets in butt configuration. Both instrumental monitoring and metallographic investigation of the welded material are carried out. The modelling of the heat source is performed by a mobile Gaussian surface source exhibiting a bi-elliptical shape. This source is implemented in a three-dimensional finite element model to compute heat flux and temperature fields. The comparison between the experimental and numerical thermal cycles shows a fair agreement. Predicted temperature fields and heat flux distributions are discussed. Conversion of isotherms into microstructural information shows that the size of the fusion zone is four times smaller than the heat affected zone dimension. The metallographic analysis confirms the expected microstructural evolutions but highlights differences between observed and predicted extents of the heat affected zone.

Keywords : Finite elements method, Three-dimensional heat fluxAjout mot clé, TIG welding, 304L steel, Heat affected zone, Fusion Zone