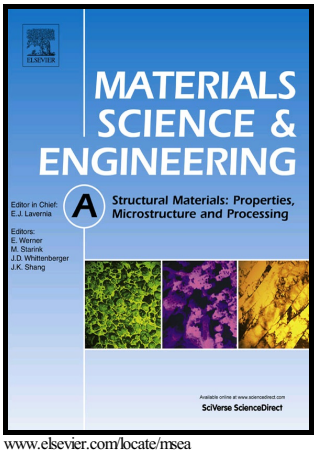

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Heterogeneities in local plastic flow behavior in a dissimilar weld between low-alloy steel and stainless steel

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Abstract

In dissimilar welds between low-alloy steel and stainless steel, the post-weld heat-treatment results in a high variety of microstructures coexisting around the fusion line, due to carbon diffusion and carbides dissolution/precipitation. The local constitutive laws in the vicinity of the fusion zone were identified by micro tensile specimens for the sub-millimeter sized zones, equivalent bulk materials representing the decarburized layer using both wet H_2 atmosphere and diffusion couple, and nano-indentation for the carburized regions (i.e. the martensitic band and the austenitic region). The decarburized zone presents only 50% of the yield strength of the low-alloy steel heat affected zone and a ductility doubled. The carburized zones have a yield strength 3 to 5 times higher than that of the low-alloy steel heat affected zone and have almost no strain hardening capacity. These properties result in heterogeneous plastic deformation happening over only millimeters when the weld is loaded perpendicularly to the weld line, affecting its overall behavior. The constitutive laws experimentally identified were introduced as inputs into a finite elements model of the transverse tensile test performed on the whole dissimilar weld. A good agreement between experiments and simulations was achieved on the global stress-strain curve. The model also well predicts the local strain field measured by microscale DIC. A large out-of-plane deformation due to the strong carburized regions has also been identified.

Keywords: Dissimilar Welding, Steels, Plastic flow properties, Nanoindentation, Digital image correlation