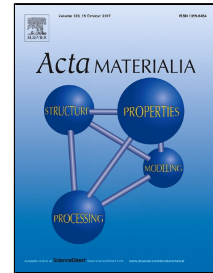


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A Simple Test for Assessing Solidification Cracking Susceptibility and Checking Validity of Susceptibility Prediction

Tayfun Soysal, Sindo Kou

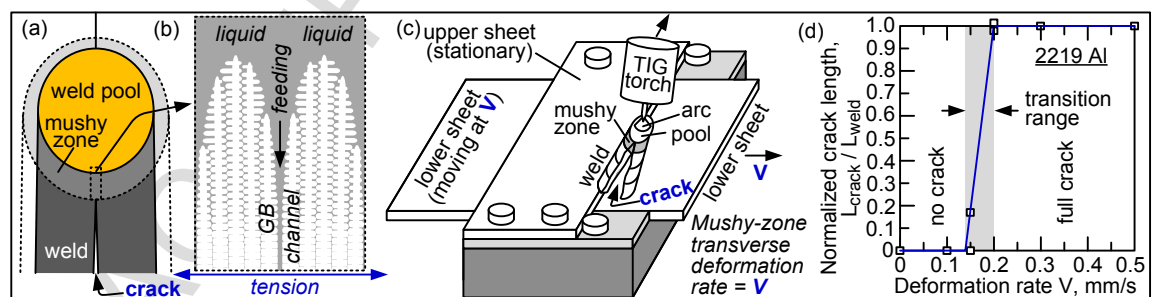


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Graphic Abstract The susceptibility of Al alloys to cracking during solidification in welding was predicted using a simple index, which is the maximum steepness $\left| dT/d(f_s)^{1/2} \right|$ of the curve of temperature T vs. the square root of fraction solid $(f_s)^{1/2}$. To check the validity of the prediction, a simple solidification cracking test was developed, in which a stationary upper sheet was lap welded to a lower sheet moving at a constant speed V normal to the welding direction. In this test V is the transverse tensile deformation rate of the mushy zone. As V was increased from zero, the transition from no crack propagation to full crack propagation occurred over a range of V , called the transition range. The crack susceptibility is lower if the transition range is located at a higher V level because a faster deformation rate V is required to cause crack propagation. It was shown that the V level of the transition range increased, that is, the crack susceptibility decreased, in the order of 6061 Al, 7075 Al, 2024 Al and 2219 Al. This observed crack susceptibility ranking is consistent with the predicted one, thus confirming the validity of the index for predicting the crack susceptibility. Since the Varestraint test has long been the most widely test for the important subject of solidification cracking, the present test is particularly significant.



Solidification cracking: (a) mushy zone; (b) grains along centerline of mushy zone under transverse tension induced by welding; (c) transverse tension induced in mushy zone by moving lower sheet while lap welding it to stationary upper sheet; (d) transition range.

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