Heterogeneous Nucleation on Second-phase Particle during Non-equialibrium Solidification

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Abstract

Three kinds of particles, Ti, Mn, and Al_8Mn_5, were introduced into fusion zone as inoculants in the AZ31 Mg alloy resistance spot welds. Microstructure was observed to be obviously refined in the fusion zone of AZ31 welds. The interatomic spacing misfit and interplanar spacing mismatch between the Mg matrix and these inoculants with different crystal structures were calculated. Ti has the best matching with the Mg matrix. In comparison, Mn has the worst matching. A variety of welding process conditions were designed so as to confirm the effect of supercooling on heterogeneous nucleation behavior. The activation energy of nucleation was found to be low for hcp Ti inoculant, medium for the Al_8Mn_5 with polytetrahedral symmetry elements, but high for the bcc Mn. TEM examination showed that good orientation relationships existed between the added particles of Ti and Al_8Mn_5 and Mg matrix. The relationship between the inoculant potency, inoculant type and size, and supercooling was discussed.