

A Model Hardness for Heat-Affected Zone Profiles in Al-Li-X Alloys

Abstract:

A model based on reaction kinetics and elemental diffusion is proposed to account for the presence of double inflection in the hardness profiles of the heat-affected zone (HAZ) in weldments of Al-Li-X alloys tested without postweld heat treatment (PWHT). Such profiles are particularly evident when 1) the base metal is in the peak-aged (T8 or T6) temper condition prior to welding; 2) the welding process is a high-heat input process, i.e., gas tungsten arc (GTA), gas metal arc (GMA) or plasma arc (PA) welding; and 3) a filler alloy deficient in lithium (i.e., AA 2319) is used. In the first part of this paper, the theoretical mechanisms are presented. It is proposed that the double inflection appears due to complete or partial reversion of the semi-coherent, plate-like precipitates (i.e., θ' or S'); coarsening of the plate-like precipitates at constant volume fraction; precipitation of θ as a result of natural aging; and diffusion of lithium from the HAZ into the weld pool due to the concentration gradient between the weld pool and the base metal. In the second part (to be published in next month's *Welding Journal*), experimental validation of the model is provided using weldments of the Al-Li-Cu Alloy 2095.