Microstructural Evolution of Cold Sprayed Al 6061

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Abstract

In this study, the microstructure of cold sprayed Al 6061 was investigated with respect to *ex-situ* heat-treatment. Advanced characterization of the as-sprayed material revealed an anisotropic macrostructure with respect to the spray direction as spherical feedstock powders were squashed into discs along the spray axis. The microstructure of these materials are characterized by three distinct regions: particle interiors, which contain a high dislocation density and coarse grains, a “squashed cell” boundary, which contains intermediate dislocation density and high-aspect ratio grains, and a “disrupted cell” boundary, which contains a very low dislocation density, and fine, equiaxed grains. Heat-treatments performed for 2h at temperature of 100 °C to 500 °C were performed on sections of this material to reveal the microstructural evolution. The secondary phases (Mg- and Fe-rich silicides) coarsen dramatically at 300 °C and 400 °C, but the Mg_2Si begins to solutionize at 500 °C. EBSD mapping reveals grain recovery and recrystallization between 100 °C and 300 °C with the area fraction of refined grains rising from about 45% in the as-sprayed condition, to about 85% in the 300 °C condition. Dramatic grain growth occurs in the 400 °C and 500 °C heat-treated conditions, with small numbers of relatively large grains dominating the interiors of prior-particle regions. Increased porosity in the prior-particle boundaries is also observed at elevated temperatures. The origins and mechanisms of these effects are discussed.