Friction Stir Processed 6061 Aluminum Cold Spray Depositions

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Nitrogen cold sprayed precipitation hardened aluminum alloys have seen a notable increase in interest in recent years. This is due, in part, to the ease of production, versatile geometries, and low cost when compared to helium carrier gas cold spray applications. The challenges faced in nitrogen cold spray applications include poor cohesion strength, low ductility, and relatively high porosity. The low cohesive strength can be attributed to the lack of robust intergranular interfacial contact from inadequate particle deformation and particle/particle boundaries entrapping particle oxide layer remnants along interlocking particle boundaries. The high porosity is due to the wide variation in particle velocity and poor particle impingement. Low ductility is unsurprising in a porous, deficiently cohesive material with numerous stress concentrators present. The aim of this research is to alleviate these problems by friction stir post-processing of the cold spray depositions. Friction stir processing is well-established as a means of controlling microstructure and improving mechanical properties. The aim is to fully consolidate the cold spray depositions and impart extreme plastic deformation to promote increased cohesion and recrystallization for improved mechanical properties. Processed samples were characterized via optical microscopy and scanning electron microscopy. Mechanical properties of the processed specimens were evaluated using uniaxial tensile testing and microhardness testing.