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# Interfacial Toughness and Selective Area Cladding of 6xxx Series Aluminum Alloys using AFSD

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## Abstract

Additive friction stir deposition (AFSD) is an additive manufacturing process based on the principal of severe plastic deformation (SPD). Here, we present the outcome of a pilot program sponsored by the Ford Poling Challenge, where we perform novel experiments to measure the fracture toughness of substrate-deposit interfaces, and use AFSD as a selective solid-state cladding and reinforcement technology for thin automotive sheet metals. Building on the selective cladding work, we characterize the basic mechanical properties of clad-substrate bi-layer systems and quantify the residual stress associated with the cladding process. We also characterize the microstructure associated with the cladding process, and some of the effects of different tool geometry on material flow fields and resulting microstructure. In general, we find the mechanical properties are affected by the thermo-mechanical process, but that the effects are consistent with friction welding literature, and that the residual stress is lower than that of traditional fusion welding technologies.

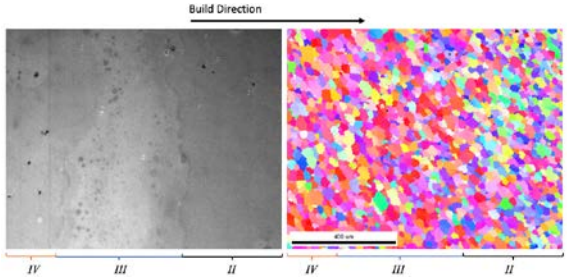


*Figure 1: SEM and EBSD images of interface between AA 6022 substrate and AA 6061 deposit. Some differences in texture can be seen across the interface, but otherwise the interface is continuous and free of discernable voids.*

## Biography

*Doug Hartley holds a B.S. in Engineering Science and Mechanics and is pursuing a PhD. in Materials Science and Engineering from Virginia Tech, expecting to graduate in 2022. He is co-advised by Dr. Hang Yu (MSE) and Dr. Dave Dillard (BEAM), working primarily on issues related to large-scale additive manufacturing of structural materials (both metals and structural composites). His area(s) of interest are additive manufacturing, thermomechanical processing, fracture mechanics, mechanical design and optimization.*