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Supersonic Particle Impacts: Cold Spray Deposition of Polymeric Material TRENTON BUSH, DAVID SCHMIDT, JONATHAN P. ROTHSTEIN, UMass Amherst — When a solid, ductile particle impacts a substrate at sufficient velocity, the resulting heat, pressure, and plastic deformation at the interface can produce bonding. The use of a supersonic gas flow to accelerate such particles is known as Cold Spray deposition. The Cold Spray process has been commercialized for some metallic materials, but further research is required to unlock the exciting material properties possible with polymeric compounds. In this work, we present a combined computational and experimental study whose aim is to define the necessary flow conditions for a convergent-divergent de Laval nozzle to produce successful bonding in a range of polymers. From our initial exploration of temperature-pressure space, we will reveal a material dependent 'window of deposition' where successful deposition is possible. Furthermore, we will present our computational work on the development of an optimized nozzle profile that maximizes particle total energy (kinetic plus thermal) upon impact and thus maximizes the likelihood of successful deposition. These predictions will be confirmed by the experimental results presented.

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