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EFFECT OF PARTICLE MORPHOLOGY ON THE PLASTIC DEFORMATION IN A COLD SPRAY PROCESS

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ABSTRACT

We investigate the effect of particle morphologies on the deformation behaviour of a copper particle depositing on stainless steel in a cold spray process. We have chosen two different shapes of particles, viz, spherical with particle sizes (10, 25 and 50 μm) and triangular (edges being 10, 25 and 50 μm). Finite element modeling using ABAQUS/explicit with a 2D axisymmetric model has been done for the analysis. Critical velocities for each of the cases have been calculated using the concept of beginning of jet formation due to the initiation of adiabatic shear instability. For the calculations, particle velocities have been considered in the range of 300 – 600 m/s. The velocity at which jetting appears is considered to be the critical velocity. For the same process parameters, the critical velocity has been shown to be similar for both the morphologies, but decreases with increase in particle sizes. The impact temperature obtained are higher for larger particle sizes irrespective of the morphology, however the deformation behaviour is shown to be different for triangular shaped particles as compared to the spherical ones. The ratio of the particle velocity and critical velocity for particle deposition is related to the flattening ratio and a measure of the deposition efficiency. Coating properties, for example, deposition efficiency, and porosity have been attributed to the difference in deformation behaviour and hence the flattening ratio. Building on these results we propose a shape and size of the powder material best suited for higher deposition efficiency and betterporosity.

Keywords: particle morphology, plastic deformation, critical velocity, deposition efficiency, cold spraying, numericalmodelling