Abstract of Understanding Deformation Mechanisms of Metal-Metal and Ceramic-Metal During Supersonic Particle Deposition

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The purpose of this project is to investigate the conditions and mechanism of bonding for supersonic particle deposition that are necessary to form ceramic-metal coatings used in satellite and rover applications. The investigation simulated particle impact that and compared the results with previous studies. We found that the conditions for single particle bonding matched previous experimental findings, with the mechanism behind the metal impacts seeming to match having deformation of the particle pass yielding and plastically deform to enable particles lock with the surface. We then continued by studying ceramic particles and finding that for ceramic particles to remain intact, they needed a lower velocity than that used in metal deposition. This means for mixed powder spraying the particles used need to more closely match each other's deposition velocity. We confirmed this with some mixed particle deposition in the most extreme case where particles directly impact at the same site. This causes the most strain to the substrate with limited coating formation capability. Our results matched previous experimental results showing that there was good bonding for metals so long as their velocity of impact was higher than the critical velocity, and for ceramics, that the metal interlocking was key to form thick bonds with the substrate. This shows that having similar critical velocity and metal on metal bonding are the primary causes for ceramic-metal coatings. This can be used to develop and better integrate ceramics in these advanced coatings.