Hybrid Bond Layers for Cold Spray Metallization of CFRP Surfaces

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To metallize surfaces by cold spray, bond layers (BL) are often used to achieve a degree of compatibility between the substrate and the deposit, and to mitigate the disparate properties of both. The objective here is to design hybrid (Al-epoxy) BL for metallization of carbon fiber reinforced polymers (CFRP), and to determine parametric effects on adhesion and yield. The few studies that have focused on metal deposition onto thermoset composites have highlighted risks of erosion of the thermoset matrix and of fiber fracture. To address these problems, a BL is introduced to reduce erosion of CFRP and to cold-weld impinging particles. Effort is devoted to engineer a BL compatible with cold spray and to develop understanding of the quantitative effects of BL microstructure on adhesion.

Design of the BL microstructure strongly affected the adhesion of cold-sprayed coating, which relied on the BL-CFRP, particle-BL, and particle-particle bonding. Results showed that continuous metal wire reinforcement was required for deposition onto thermosets. The first few layers of bonding relied on partial erosion of epoxy exposed in mesh openings, followed by filling of the eroded regions, creating interlocking of cold-sprayed particles and Al mesh wires. Erosion of the BL epoxy roughened the surface, increasing the surface area for particle interlocking with the Al mesh, and creating a tortuous interface profile. Refinements of the BL microstructure have potential to expand the use of cold spray to impart metal-like durability to polymers and composites for resistance to erosion and impact, increased conductivity, and facilitating rapid repair.

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