Effects of cold spray parameters on microstructure and adhesion of titanium deposited on PEEK

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The objective of this work is to determine the effects of gas temperature and pressure on the interface microstructure and adhesion of cold-sprayed titanium on PEEK at two powder feed rates. There is a need to understand the effects of cold spray parameters on interface microstructure, and the quantitative effects of microstructure on metal adhesion to thermoplastic substrates. The competition between avoiding substrate erosion and achieving cold-weld of impinging particles via severe plastic deformation (SPD) dictates a critical bond layer thickness. A different recipe to enable SPD of impinging particles should be used for coating build-up, but the critical thickness at which the second recipe should be used is not well-defined.

Adhesion of cold-sprayed coating is determined by the particle-substrate and particle-particle bonding. Particle-substrate bonding relies on mechanical interlocking and localized melting. Interface roughness and particle coverage of the fracture surface indicated degree of mechanical interlocking and relative bond strength of particle-substrate vs particle-particle, respectively. Interface roughness depended mainly on gas temperature, and reduced particle coverage indicated less effective embedment of particles. The second cold spray recipe should be used on top of the bond layer. The bond layer thickness can be approximated from the maximum height of the fracture surface.

Steps to increase the adhesive strength of cold-sprayed titanium on PEEK through quantifiable microstructures are shown. This systematic approach allows efficient selection of cold spray parameters for different material combinations. Interface engineering of the bond layer microstructure is essential to cold spray well-adhered metal overlayers on polymers.