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Cold spraying for additive manufacturing and repair

T Klassen, S Krebs, K Binder, M Villa-Vidaller, F Gärtner, T Gartner and H Assadi

Helmut Schmidt University, Hamburg, Germany
Helmholtz-Zentrum Geesthacht, Centre for Materials and Coastal Research GmbH
Lufthansa

Abstract. Materials with high specific strength are required for aerospace applications. This presentation focuses on deposition of Ti and Al alloys as well as bronze by cold spraying, in view of cost-effective near net shape production of bulk parts, as well as refurbishing of used parts. Comprehensive understanding of the cold spray process allows for systematic optimization of process parameters. A generalized parameter can relate process conditions and feedstock powders with coating properties such as porosity, mechanical strength and electrical conductivity [Assadi et al., J. Thermal Spray Techn. 20 (2011) 1161]. This unifying process variable considers even complex interdependencies between several process conditions, and thus reveals unexpected tuning potential. For example, for most high strength materials, higher impact temperatures and higher impact velocities are desired. However, detailed analysis shows that, for some materials, lower pressures actually yield better results. This obviously applies to materials with limited deformability at higher strain rates, but also to materials with low density and/or powder cuts with smaller particle sizes. The concept facilitates prediction of prospective coating performance, and a respective user software tool is available. In addition, for comparison of cold spraying with thermal spraying, a generalized concept based on impact energy will be presented.
Based on the scientific understanding, dense deposits with tensile strengths up to the level of respective bulk material are successfully achieved, demonstrating that cold spraying is a powerful and energy efficient tool for additive manufacturing and repair.