Micromechanical Characterization of Cold-Sprayed Al-6061 Coatings

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The micromechanical characterization of cold spray coatings is of great interest as the process yields two microstructural distinct regions; the centers of the particles, which are comprised of an equiaxed grain structure, and the particle boundaries, which are comprised of a squashed grain structure that are formed by significant deformation and recrystallization. Here, *in-situ* micro-compression and nanoindentation results are presented from cold spray trials of as-atomized and isothermally heat-treated Al-6061 coatings. The following results were observed. (1) There is a clear distinction in hardness between the interior regions of the individual constituent particles and the boundary regions which is explained by extreme differences in grain size. (2) The unique microstructure of the coating leads to a non-uniform response to heat-treatment. The mechanical data indicated the majority of grain refinement begins to occur at ~300°C with the entirety of constituent particles consumed by a single grain at ~400 °C, after which the microhardness decreases substantially. (3) The yield strengths of the cold spray coatings are significantly higher than those observed within single particle impact experiments. Subsequent impacts as well as increased time under the cold spray stream leads to grain refinement within the microstructure which results in an increase in yield strength of up to ~100MPa. Furthermore, we present a simple mathematical model that accurately predicts the bulk yield strength of the coating from the micromechanical data. We note that our approach can be used more generally to study other cold spray coatings and give important insight in the fundamental understanding of the mechanical behavior cold spray materials.

Biography of the presenter

Tyler Flanagan is a graduate student (Ph.D. program) in the department of Materials Science and Engineering at the University of Connecticut. He obtained his Bachelor of Arts degree in Physics from Clark University in 2014.