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### **EVALUATION OF COLD SPRAY FOR AIRCRAFT REPAIR**

#### **Abstract**

Aircraft parts are subjected to stringent regulations to maintain airworthiness. As a result, minor corrosion or mechanical damage can disqualify a part and require replacement even though the majority of the part is acceptable. For complex parts that are difficult and expensive to manufacture in low production runs, it can be more economical to use an additive manufacturing repair process such as cold spray (CS) repair to restore the original part geometry without manufacturing an entire part. This extends the life of existing parts and thereby, extends the usable life of the aircraft. Substantiation is the first step to achieving certification for the repair on certified aircraft.

A logical and conservative analysis approach to substantiate the repair of non-structural and structural parts has been developed using stress analysis and material property generation. Often prior to the substantiation, a comprehensive test matrix is carried out to determine the material allowables of the cold spray material system. The substantiation analysis incorporates this new information in a logical progression. The result is a process that is useful for non-structural and ultimately structural part repair.

Cold spray is being used in both civil aviation and military aircraft fleets as a method for repairing obsolete or damaged parts mainly for dimensional repair. There is ongoing research examining the corrosion and mechanical property equivalency of CS repairs on aluminium alloys for structural applications on aircraft. Coupon testing has shown that CS repairs of fatigue sample geometries with 15-30% blend out depths are able to improve fatigue life to near that of pristine fatigue coupons. Tensile coupons with 15% depth CS repairs have also shown tensile properties within 90% of wrought material for two aluminium alloy systems. Bending and pin-bearing testing has also been conducted; both show excellent bond performance of the cold spray and acceptable mechanical properties. All the work developing coupon data is critical to building the material database which will allow for additively manufactured or repaired parts to be installed on aircraft.

#### **Biography**

Ms. Sarah Galyon Dorman joined the SAFE Inc in 2011. She currently serves as the Vice President-Principal Scientist for all research and development programs. Her programs focus on aircraft structural certification of an additive manufacturing process (cold spray), environmental effects on cracking of modern and legacy aluminum alloys, inhibitor effects on complex environmental cracking, and engineering student development. Sarah also has experience with root cause failure analysis, mixed mode crack growth and environmentally assisted cracking. She received a Bachelor of Science degree from Virginia Tech in Materials Science and Engineering, followed by a Master of Science from the University of Virginia.