



LMS Seminar

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Study of electrically conductive coatings produced by cold spray onto brittle and thermosensitive substrates

Patrizio Lomonaco

LMS, Ecole polytechnique

ABSTRACT

The cold spray process is industrially assessed only for the assembly of metal onto metal. Nevertheless, it offers several technological advantages over the other thermal spray processes because it is based on kinetic rather than thermal energy. This feature increases the possibilities to deposit coatings onto brittle and thermo-sensitive substrates, such as polymer and polymer based composites. The main goal of this work was to develop strategies to achieve the metallization of short carbon fiber reinforced PEEK composites by both high pressure and low pressure cold spray. The phenomena involved in such a process were investigated. To increase the adherence and reduce the delamination of pure aluminium coatings, a powder mixing strategy was employed. Pull-off adhesion tests and electrical conductivity measurements were carried out to understand the effect of PEEK powder content in the mixture. A fluid dynamic model was developed to better understand the phenomena involved in both high and low pressure cold spray process. Experimental measurements of particle velocities, together with computed particle temperatures, were used as initial conditions for finite element simulations of particle impact onto the composite. A coupled eulerian-lagrangian approach in an explicit analysis was used to simulate single and multiple particle impact. In conclusion, this work engaged several techniques, both experimental and numerical, and original approaches were proposed to investigate and improve the cold spray process in the case of thermo-sensitive and brittle substrate materials.

BIOGRAPHY

Dr. Patrizio Lomonaco is a post-doc researcher in LMS laboratory of the Institut Polytechnique de Paris on “Integration of optical fibers with multiplexed Bragg gratings by metal additive manufacturing direct energy deposition and thermal spray for the measurement of thermo-mechanical fields in bulk metal pieces”. Born as a rocket scientist after the Master of Science in Space and astronautical engineering at Sapienza University of Rome, his studies were focused on the CFD analysis of multispecie under-expanded jet flow of Vega C launchers Z40 second stage solid rocket motor. In a post graduated master course worked in the structural department of AVIO s.p.a as intern carrying out numerical simulations for the study of the integration of Bragg gratings fibers in the Z40 solid rocket motor composite structure. During his Ph.D. at Mines-Paris PSL materials laboratory he worked on the thermal spray (cold spray) in order to produce conductive coatings onto short fibers reinforced PEEK based composites and onto several other thermo-sensitive substrates. Experimental test as well as CFD simulation of the entire cold spray process (with OpenFOAM software) and simulation of multiparticle impact onto composite substrates (Abaqus) were carried out. In the 2021 he was a co-founder of a small enterprise (called CPAMAL) using thermal spray for art and craft applications.