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MICROSTRUCTURE-INFORMED MODELLING OF THE FATIGUE STRENGTH OF ADDITIVELY MANUFACTURED METALLIC MATERIALS

M. MADIA[*], L. PATRIARCA[†]

[*] Bundesanstalt für Materialforschung und -prüfung (BAM)
9.4 Integrität von Schweißverbindungen, Unter den Eichen 87, 12205, Berlin, Germany
mauro.madia@bam.de
www.bam.de

[†] Department of Mechanical Engineering, Politecnico di Milano, Italy
via La Masa 1, 20156, Milano
luca.patriarca@polimi.it
www.polimi.it

ABSTRACT

In the last years, the Additive Manufacturing (AM) process has seen a rapid growth from part prototyping to large scale production even for industrial applications requiring components with high load-carrying capability. A major concern is ensuring the structural integrity of AM-fabricated metallic materials, in particular regarding their fatigue behavior. The complexity of the manufacturing process and the number of influencing parameters strongly affect defect formation, microstructure, residual stress, which, in turn, have a major impact on the fatigue. Following the increasing industrial demand for part qualification, the focus has progressively shifted towards the development of precise and accurate predictive models for evaluating the fatigue performance of AMed materials which can properly account for the key features of the AM process. The understanding of the process-structure-property-performance relationship still represents the key challenge for the qualification of safety-relevant parts. Therefore, the development of predictive multi-scale models based on microstructural features would be highly desirable to simulate complex phenomena such as the fatigue process. The purpose of this invited session is to provide a forum for fostering discussion between the modelling and testing communities to enhance the simulation and industrial application of AMed metallic materials. Topics of interest include, but are not limited to: microstructure-informed modelling; role of process defects, including surface roughness; use of machine learning; advanced techniques for microstructural characterization; statistical modelling.