

KEYNOTE - THE ROLE OF PROCESS DESIGN AND MODELLING IN THE QUALITY ASSURANCE OF ADDITIVELY MANUFACTURED METALLIC COMPONENTS

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Although the capability of AM for the generation of components of a high geometrical complexity has been widely demonstrated, the final surface and structural quality of these components is, in many cases, far from the specifications required by their service conditions. This is mostly due to temporal process fluctuations, possible spatial heterogeneities and modified grain formation kinetics leading to critical variations at the microstructural level through unpredicted thermal, mechanical and chemical signatures deviations. This lack of practical predictability, that is unusual in traditional subtractive manufacture, is one of the present-day main limitations of AM processes face to the crucial point of components qualification for high reliability applications.

As a consequence of these particular features, that are particularly apparent in metallic components, the specially suited predictive design and close in-process quality assessment of the manufactured components play a fundamental role in view of the final thermal/mechanical/chemical performance to be fulfilled under service conditions.

The development of comprehensive predictive assessment tools with integrated process parameters for the design of the manufacturing process itself along with the associate tools for in-process quality monitoring and assessment has thus resulted in a key issue for the successful manufacturing chain of AM'ed components, especially those built from advanced metallic alloys susceptible of broad metallurgical transformations during the deposition process.

In the present communication, the (very wide) general frame of the model-based design of additively manufactured metallic components in view of their final industrial qualification is presented along with an overview of the corresponding process predictive assessment and monitoring tools envisaging such critical step.

Finally, some practical examples on the application of the described strategies to particular industrial AM cases will be presented.