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Integrated analysis and quality control of laser-based additive manufacturing processes

Modelling and simulation are recognized to be called to play a critical role for the design and optimization of components and materials in additive manufacturing, advancing the capability to quantify the influence of process variables on the resulting components properties and performance. Models for the consideration of different material behavior approaches and physical scales are needed for a fundamental understanding of the underlying physical processes and their repercussion on the final component properties and behavior. Even considering the development of the AM process in itself, a lot of physical phenomena and material transformations have to be taken into account and multiple length and time scales have to be handled under different approaches depending on the physical state or phase of the material at each instant. The development of integrated models considering in a coupled way all the issues relevant to the obtention of high quality components fabricated by AM from basic raw materials continues to be a major challenge and is foreseen to deserve large scientific and technological efforts in view of the inherent difficulties to handle in a coupled way the referred length and time scales together with global predictive assessment tools and quality assurance monitoring and control procedures. In the present paper, particular strategies developed for the experimentally contrasted predictive assessment of AM processes are presented. Applied modelling strategies have been developed trying to provide useful tools for the practical development of AM'ed components, both with a fundamental insight into the process from a micro/mesoscopic point of view and with a practical orientation to process monitoring and quality control, as required from a practical process implementation perspective.

Recent Publications

1. D Huerta Murillo, A García Girón, J M Romano, J T Cardoso, F Cordovilla, M Walker, S S Dimov and J L Ocaña (2019) Wettability modification of laser-fabricated hierarchical surface structures in Ti-6Al-4V titanium alloy. Applied Surface Science 463:838-846.
2. P Sancho, F Cordovilla, J Dominguez, M A Montealegre, J Isaza, A García Beltrán and J L Ocaña (2019) Customized laser beam intensity distribution for the laser surface treatment of geometrically convoluted components. Journal of Materials Processing Technology 263:223-232.
3. F Cordovilla, A García Beltrán, M Garzón, D Muñoz and J L Ocaña (2018) Numerical-experimental study of the consolidation phenomenon in the selective laser melting process with a thermo-fluidic coupled model. Materials 11:1414-1430.
4. J P Oliveira, A J Cavaleiro, N Schell, A Stark, R M Miranda, J L Ocaña and F M Braz Fernandes (2018) Effects of laser processing on the transformation characteristics of NiTi: A contribute to additive manufacturing. Scripta Materialia 152:122-126.

5. D Huerta Murillo, A I Aguilar Morales, S Alamri, J T Cardoso, R Jagdheesh, A F Lasagni and J L Ocaña (2017) Fabrication of multi-scale periodic surface structures on Ti-6Al-4V by direct laser writing and direct laser interference patterning for modified wettability applications. Optics and Lasers in Engineering 98:134-142.

Biography

José L Ocaña has completed MSc (1979) and PhD (1982) in Industrial Engineering (Energy) at the Polytechnic University of Madrid, Spain. He is Chair Professor of Mechanical Engineering at the ETSII-UPM School of Engineering and Director of the UPM Laser Centre at this University (1999-2016). He is active promoter and participant in national (Spain) and worldwide R&D initiatives in the field of scientific and industrial applications of high power lasers, especially in high-intensity laser-matter interaction, laser welding, laser surface treatments, laser micromachining, laser additive manufacturing and on-line monitoring and control of industrial laser applications. He is Author/coauthor of more than 200 scientific papers and more than 250 communications in the field of laser technology and applications. He is a Member of multiple scientific committees and editorial boards in the field of laser technology and applications. He is a Former Chairman of EULASNET II (Eureka Umbrella Network for Laser Technology and Applications; 2006-2010) and Vice-President of the Executive Board of the European Laser Institute (ELI; since 2013). He was awarded several prizes related to his research activity.

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