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Advanced Materials Science Research

Optics – New requirements in smart laser processing

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Biography

Wojciech Suder is a lecturer in laser processing and welding science with the main focus on high power laser processing and development of novel welding processes and systems. He has been working at Cranfi eld since 2012 as a researcher and then since 2016 as a lecturer. He holds a in laser welding from Cranfi eld University and M.Sc in Materials Science from Gdansk University of Technology. His research interest is in understanding fundamentals of laser material interactions, process science and development of high power laser processes, such as thick section welding, hybrid welding, additive manufacture and pulsed laser processing. He works actively towards promoting more robust "black art", free laser processing, by encouraging better understanding of laser processing amongst the laser users.

Abstarct

The precise control of spatial and temporal distribution of the energy delivered to the work piece is the main benefit of lasers. This can be achieved either by changing the size and shape of a laser beam or by changing the temporal regime from continuous wave to pulsed wave or by applying different intensity distributions. Development of more advanced beam delivery in recent years, such as beam shaping, dynamic beam manipulation and variable focus enabled additional control of material response during laser material processing; yet most manufacturing processes use simple axisymmetric heat sources. Most advanced materials require a careful control of applied energy, which can only be achieved with accurately controlled energy profi les tailored to a particular case. This work shows the importance of laser optics in controlling the applied energy and the resulting material response in order to achieve robust laser processes. Different laser processes were investigated with the emphasis on the response of the material to the applied energy and its effect on the melting behaviour, weld bead profile, defects and microstructure. It has been shown that the temporal and spatial energy distribution of a laser is the key factor controlling the process regime, melt pool and microstructural development. A new concept of high deposition rate net shape additive manufacture with the utilization of multi-energy sources is discussed, in which the energy profile is designed to maximize the melting efficiency of the feedstock material and enable independent control of the shape of deposited beads and thermal input. This shows that to utilize all benefits of lasers and achieve highly controllable, robust and accurate laser processing a new type of optical systems with tuneable temporal and spatial output is needed. Such systems, integrated with the real time process monitoring and smart processing algorithms, open new possibilities for smart laser processing.

Publications

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