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Challenges in high power laser processing

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Lasers enable precise control of spatial and temporal energy, high precision, directionality, non-contact interaction with materials and delivery of well-defined wavelength. This makes them one of the most flexible tools widely used in various applications of material processing. However, most manufacturing processes use simple axisymmetric heat sources, and the processing parameters are often developed based on a parametric approach, without considering the material requirements and therefore not utilising the full potential of lasers. Most advanced materials require a careful control of applied energy, which can only be achieved with accurately controlled energy profiles tailored to a particular case. The energy profile and its delivery rate determine the interactions with the material, such as the heating rate, extent of melting or vaporisation, temperature gradient and driven by it melt flow, solidification rate and microstructural development. This, in turn, controls the final product, such as weld bead shape and mechanical properties in welding, cut roughness in cutting, quality of ablated surface in machining or smoothness and dimensions of deposited beads in additive manufacture. This work shows the importance of understanding laser material interaction and the role of optics in the control of delivered energy. Different high power laser processes were investigated with the emphasis on the material's response to the applied energy and its effect on the final product. The results show that to utilize all benefits of lasers and achieve highly controllable, robust and efficient laser processing, a new type of optical systems with tuneable temporal and spatial output, integrated real-time process monitoring and smart processing algorithms are needed. This opens new possibilities for smart laser processing.

Biography

Dr Wojciech Suder - a senior lecturer at Cranfield University working on various projects in laser processing and arc welding. In the last 10 years he has been working on understanding fundamentals and process development of high power laser processes, such as thick section welding, hybrid welding, additive manufacture and pulsed laser processing. He holds a PhD in laser welding from Cranfield University and an MSc in Materials Science from Gdansk University of Technology. He works actively towards promoting more robust "black art"-free laser welding, by encouraging better understanding of laser welding amongst the laser users. His work, therefore, has been strongly applied and closely collaborative with various industries.

SESSION SPEAKER