Special Issue

Laser Welding of Steels and Alloys

Message from the Guest Editor

Laser welding is a transformative technology in advanced manufacturing, offering high energy density, a small heat-affected zone, and compatibility with various materials, including high-strength steels, titanium alloys, and dissimilar metals. It is widely adopted in automotive lightweighting, aerospace, and energy systems, supported by innovations like laser–arc hybrid welding and ultrafast lasers for low-damage processing of brittle materials. Key challenges remain, including instability in reflective metals, intermetallic formation, and high equipment costs. Current research focuses on multiphysics modeling of keyhole dynamics, defect control (e.g., beam oscillation to reduce porosity), and intelligent process monitoring using machine learning and digital twins. Sustainable approaches like low-power blue lasers and vacuum oxidation prevention aim to improve scalability and reduce environmental impact.

This Special Issue presents recent studies on laser welding technologies and the structure–microstructure properties of welded steels and alloys. Reviews and contributions on alloy processing, heat control, process stability, and weld quality are also welcome.

Guest Editor

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Metallic materials play a vital role in the economic life of modern societies; contributions are sought on fresh developments that enhance our understanding of the fundamental aspects related to the relationships between processing, properties and microstructure – disciplines in the metallurgical field ranging from processing, mechanical behavior, phase transitions and microstructural evolution, nanostructures, as well as unique metallic properties – inspire general and scholarly interest among the scientific community.

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