National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: Effects of Direct and Hybrid Laser Processing on Fe-Cr-Ni Enriched Alloys during Fabrication of Surface Features: A Comparative Analysis on Material Ablation Behavior, Dimensional Aspects and Surface Characteristics
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Venue	: ME Dept HOD Room
Date and Time	: 02 Jul 2024 (4.30 PM)
Abstract	: A Fe-Cr-Ni enriched alloy holds the beneficial properties that have high strength, excellent corrosion resistance, and good mechanical properties. The most pronounced Fe-Cr-Ni enriched alloys are A4SS and SDSS-2507. However, being a dual-phase material SDSS-2507 is a combination of desirable properties of individual phases. That makes it difficult to process by any means due to its lower machinability index. However, a new era Yb:YAG fiber laser technology has the remarkable ability to spur innovation and expand the limits of what can be achieved in processing these materials. Since direct laser processing (DLP) is a temperature-dependent process, it causes surface heating with melting, exhibiting a reciprocal relationship between productivity and processing quality. As a consequence, it causes several surface imperfections and oxidation. If it falls short of finding a viable remedy, it inevitably leads to material property depreciation. In order to overcome such problems hybrid laser processing (HLP)holds its dominance considerably in the field of innovation which brings new standards to the products concomitantly with higher productivity. Apart from this, while processing with a laser by any means, scan mode is a crucial processing window through which the major laser energy controllers can be directed, especially for the fabrication of simple to intricate surface features. Based on such major points, the current research objectives are framed. At the primary stage, an experimental investigation was carried out on scan modes like AFSM and O-OLPS with the other laser processing variables during the fiber laser micromachining approach (FLMMA) In order to provide insight into contemporary scan modes, the current research also scrutinized the channel&rsquos dimensional and surface traits. The research outcomes revealed that the O-OLPS performs well compared to AFSM. In the second stage, O-OLPS is asserted in this study for producing micro-channels on A4SS and SDSS-2507 As FLMMA is one of the most demanding manufacturing processes, this research aims to enhance the FLMMA by introducing O-OLPS in DLP and HLP as an existing industrial potential by altering the laser processing variables via tailoring the scan factors of the fiber laser. The core goal of this research is to scrutinize the materials&rsquo responsiveness like dimensionality, material ablation, and surface traits. It has been observed that the formation of defects and oxides is higher in A4SS compared to SDSS-2507. In the final stage, the versatility of O-OLPS was scrutinized under varied environments like DLP, active and inactive gas-supported laser processing (A and IA-GSLP), and chemical-supported laser processing (CSLP) during the fabrication of a multi-pattern integrated surface (MPIS) feature In order to acquire insight into the DLP, GSLP, and CSLP effects, different surface characterizations were performed. It has been found that by taking advantage of O-OLPS, surfaces processed under NaCl-CSLP and A-GSLP exhibited superior performance in terms of material ablation rate among the other environments, whereas the IA-GSLP solely performed well in terms of a clean surface with minimal leftover residue after H_3PO_4. On top of that, when compared to before laser processing, the corrosion rate was found to be lower in case of H_3PO_4-CSLP compared to all. Based on the facts presented above, it can be concluded that the MPIS that was fabricated using H_3PO_4-CSLP outperformed the others in every respect, and it can possibly maintain its integrity and functionality in any harsh environment, especially marine without significant degradation.