FZU
Institute of Physics of the Czech Academy of Sciences

SEMINAR

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Seminar hall
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Improving Surface Characteristics of SLM Printed Miniature Gears in LPwC

Micro and miniature components are vital players in manufacturing industries, especially aerospace, automobile, electronics, telecommunications, information technology, and medical industries. The high demand for smaller and functional appliances, machines, and parts in worldwide economies is increasing rapidly owing to their modest volume, lightweight, portability, and reliable efficiency. Components with a size spectrum from 1 to 1000 μm are referred to as micro-components. They are frequently used in several micro-devices, micro-systems, and micro-products. In the recent decade, attention has been paid to producing these products. The post-processing of the micro-manufactured products by mechanical means (such as heat treatment and shot peening) is also considered a challenging task due to their small size, lower material availability, risk of thermal damage, and mechanical distortions. Laser shock peening (LSP), or laser peening, is an efficient technique to enhance the resistance of micro-manufactured parts to damage by foreign objects and improve fatigue life. LSP can potentially enhance the mechanical and metallurgical properties of micro and miniature parts due to its deep penetration capabilities, better surface quality, and unaltered geometry of the treated components. Increasing world requirements for small and effective appliances and gadgets have accelerated the demand for additively manufactured (AM) micro and meso components. The service life of the micro/meso sized parts is strongly tied to the AM surface quality and integrity. This work presents a surface integrity improvement of selective laser melting manufacturing manufactured 10 mm sized meso gears using the unconventional technique of Laser Peening without Coating (LPwC). Low-power 200 mJ to 1000 mJ laser pulses were applied underwater in the gear root and fillet gap generating significant surface compressive residual stresses.

Moreover, improved surface quality features in terms of roughness and material ratio curves have also been observed. Scanning electron microscopy and electron backscatter diffraction helped in analyzing the grain refinement in LPwC. The outcome of this research will be useful for industries and researchers working with micro/meso parts.

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