FZU
Institute of Physics of the Czech Academy of Sciences

SEMINAR

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Seminar hall
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Post Processing of 3D Printed Meso-sized Gears in Laser Shock Peening

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 quickly and steadily due to their modest volume, lightweight, portability, and stable efficiency. The residual stresses caused by micro-manufacturing procedures or surface modification methods in micro and small parts or components play a significant role in assessing their service life. Most of the micro-manufacturing processes, such as micro-milling, micro-powder injection technology, micro-molding, extrusion, micro-stamping, additive manufacturing (3D printing), etc., cannot produce the required residual stresses in the substrate material, and they eventually result in lowering the fatigue life of the developed components. Due to fatigue, the micro-manufactured components working under high temperature and corrosive environments such as sensors, nozzles, and valves fail.

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 damages, 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 the fatigue life. LSP has the potential to improve the mechanical and metallurgical properties of micro and miniature parts due to its *capabilities of deep penetration, better surface quality aspects, and unaltered geometry of the treated components*.

In the present work LSP has been introduced as a complete post-processing solution for additively manufactured meso-sized spur and helical gears in the present work. The details of gear, its essential characteristics, and planning for improving its surface integrity and quality have been presented. The challenges and opportunities in improving the overall quality of gears have been considered precisely during the processing of gears by LSP. The results have shown considerable improvements in surface quality (in terms of surface roughness and Microgeometry) and surface integrity (in terms of microstructure and residual stresses) in the meso sized spur and helical gears. The outcome of this work will pave a foundation to utilize LSP for miniature parts.

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