# Seminar

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# Institute for Plasma Research

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**Title:** Laser generated micro/nanostructures on metallic surface: Its implications in biomedical engineering and laser induced breakdown spectroscopy

**Speaker:** Dr. P Chandrakanta Singh
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**Date:** 08th July 2025 (Tuesday)

**Time:** 10:30 AM

**Venue:** Seminar Hall, IPR

## Abstract

Generation of laser induced micro/nanostructures on the metallic surface are the area of current interest because of its importance in improving the functional performances for its utilization in biomedical engineering, industrial applications and laser induced breakdown spectroscopy (LIBS). By realization of the fact that morphology of the ablating surface greatly influence the opto-thermal properties and hence the spectral emission, the simple and effective approach has been proposed to enhance the LIBS efficiency by generating the microstructures on the ablating surface. The experiment clearly signify the role of surface texturing in the LIBS where spectral intensity of constituents species enhanced by many folds as compared to observed intensity in conventional method. Also, the detection sensitivity of trace elements are improved remarkably in textured surface. Further, laser induced texturization also modified its morphology, tribology, and wettability properties which are the most important parameters in its utilization in biomedical applications. These parameters are highly depends on the shape, size and distributions of the generated structures on the surface. In view of above we have attempted to generate ripples and microgroove like patterns on the pure titanium (Ti) surface using pulsed nanosecond Nd:YAG laser. Titanium is chosen because of its extensive use in biomedical devices. Different scanning schemes and laser processing parameters are used to optimize size, distribution and pattern of the surface structures. Emphasis is given on the manipulating the wettability behaviour from hydrophilic to hydrophobic by changing the texture characteristics which have the specific applications in biomedical implants. Role of scanning schemes and laser parameters on the variation of surface structures are briefly addressed. The observed result are also correlated with the surface chemistry of textured material by spectral analysis of LIBS signal. It has been observed that oxygen rich surfaces give the superhydrophilicity due to high oxide formation, while carbon and nitrogen enriched surfaces support superhydrophobicity.

In continuation of the present work, the in-vitro biocompatibility assessment (cell adhesion, cell growth, antibacterial) will be carried out for the best performing textured as per present observation. Also I am working on the dopant profiling and defect mapping in the silicon semiconductor using the LIBS

technique. Successful operation of this experiment give an advancement in characterization tool.

**Reference**


1. **P. Chandrakanta Singh** and R. K. Singh, "Generation of micro/nanostructures on the brass by nanosecond laser: A comparative study of LIBS signals for untextured and textured surface," Opt. Mater. 162(5):116869 (2025). https://doi.org/10.1016/j.optmat.2025.116869
2. **P. Chandrakanta Singh** and R. K. Singh, "Analysis of LIBS signals on laser induced textured surface," Proceedings of 33rd DAE - BRNS National Laser Symposium (NLS-33) on March $6^{th}$ – $9^{th}$, 2025 at Medi-caps University, Indore, M.P.
3. **P. Chandrakanta Singh** and R. K. Singh, "Laser generated micro/nanostructures on the titanium surface for its implications in biomedical engineering" Submitted in IPR intra.