Periodic surface nanostructures induced by femtosecond pulsed laser on metals, semiconductors and topological insulators

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Femtosecond pulsed lasers, with ultra-short flashes of light, induce periodic surface nanostructures through a process called laser-induced periodic surface structures (LIPSS). These structures exhibit nanoscale ripples or grooves on various materials, including metals, semiconductors, and dielectrics. The formation of LIPSS involves complex interactions between the intense laser light and the material surface, leading to rapid melting, solidification, and material ablation. The period and orientation of these nanostructures can be controlled by adjusting laser parameters such as pulse duration, energy, and polarization. LIPSS find applications in diverse fields, including surface engineering, nanofabrication, and optoelectronics. Understanding the dynamics of LIPSS formation is crucial for tailoring surface properties and enhancing material performance. Advanced characterization techniques like electron microscopy and spectroscopy provide insights into the morphology and optical properties of these nanostructures. Exploiting LIPSS offers opportunities for creating functional surfaces with tailored properties for applications ranging from optics and sensing to biomedical devices. In this talk, surface functionalization of different materials as copper [1, 2], silicon [3] and topological insulator Bi_2Te_3 [4] will be explored demonstrating the wide range of possibilities offered by femtosecond laser micromachining in modifying and enhancing surface properties.

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