

MATERIALS ENGINEERING SEMINAR

“Laser-Assisted Selective Processing of Metal Surfaces for Multifunctional Device Applications”

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Purdue MSE Ph.D. Final Exam

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ABSTRACT

Developing functional metallic nanostructured surfaces has seen significant growth in various applications, including sensors, electronics, and biomedical devices. However, conventional fabrication techniques for these nanostructures face limitations such as complexity, high costs, and unstable coatings. Laser-assisted surface processing has emerged as a promising solution to address these challenges by enabling localized processing and modification without altering bulk properties. This dissertation focuses on the development of multifunctional devices using selective laser processing of metallized surfaces, categorized into three routes. The first part explores the utilization of laser-induced oxides (LIO) for simple processing and formation of functional metal oxide nanostructures as electrochemical sensing elements. Different laser processing conditions were systematically studied for cost-effective metals like copper and nickel, evaluating their potential as non-enzymatic glucose sensors. The second part investigates laser selective processing for removing metal coatings on temperature-sensitive substrates, providing a cost-effective and scalable alternative to conventional photolithography and etching processes. Various laser processing conditions were examined to achieve selective patterning of metalized fabric structures for wearable electronics production. The third part explores localized laser processing to create intermetallic nanotexturing mixtures without altering bulk properties. The study involved silver spray-coating onto titanium implants, followed by a post-laser processing. The aim was to achieve simultaneous texturing and intermixing of silver in titanium alloy structures, enhancing antibacterial properties and bone mineralization while preserving mechanical properties.

Through the comprehensive examination of these three routes, this dissertation demonstrates the immense potential of commercial laser processing systems in the design, fabrication, and characterization of functional metallic nanostructured surfaces. It emphasizes the often-overlooked aspect of chemical alterations in laser-assisted surface processing, bridging the gap between physical and chemical modifications. The research opens new avenues for the development and optimization of multifunctional devices in electronics and biomedical applications.

Date: Tuesday, August 1, 2023

Time: 2:00 P.M.

Place: MRGN 129 at Burton D. Morgan Center for Entrepreneurship, and via Webex:

<https://purdue.webex.com/join/rrahimi>



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