

**MATERIALS ENGINEERING
SEMINAR**

“Nondestructive Processing of Printed Bimodal Materials for Fabrication of Multi-Functional Flexible Devices”

By

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ABSTRACT

Printed electronics (PE) is one of the fastest-growing technologies in the 21st century. PE refers to the additive deposition of materials to fabricate electrical circuits, interconnects, and devices. Recent reports have shown that the PE market will reach 4.9 billion by 2032. The quest for developing nondestructive processes that enable the additive manufacturing of low-cost PEs on heat-sensitive substrates with novel functionalities has resulted in several recent developments in the field, which include the investigation of selective and optical sintering processes such as photonic sintering and laser sintering, to name a few. This dissertation is an effort to study these sintering technologies for additive manufacturing of bimodal (metal/metal, metal/inorganic, and metal/organic) printed material compositions. In the first section, nondestructive sintering technologies are combined with chemical sintering to develop bimodal metallic conductive pastes for the fabrication of biodegradable and non-biodegradable printed devices for applications in food packaging and wireless smart drug delivery. Next, a process is developed via near-infrared (NIR) technology to enable soldering and mounting electrical components onto printed materials using low-temperature bimodal metal/organic solder pastes. The developed, optimized process is used to fabricate a flexible printed hybrid device for remote assessment of wound exudate absorption in dressings. Lastly, laser processing is used to effectively form an antibacterial bimodal silver-containing glass ceramic coating directly on temperature-sensitive polymeric surgical meshes. The integrated bioceramic coating on the mesh exhibits long-lasting antibacterial properties against Gram-positive and Gram-negative strains of bacteria. The results of this dissertation will open a new route for scalable and cost-effective manufacturing of high-performance multifunctional flexible devices for a broad range of applications, from food packaging to healthcare devices.

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