MATERIALS ENGINEERING

SEMINAR

"E-Textiles by Programmable Overcoat of Functional Materials"
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Purdue MSE Ph.D. Final Exam

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ABSTRACT

Textiles are popular for wearable products due to their potential for wearability, comfort, flexibility, breathability, and seamless fit to the human body. The increasing demand for remote telehealth monitoring has advanced the field of e-textiles. While various approaches like dip coating, screen printing, inkjet printing, and vapor deposition are used to overcoat fabrics with active nanomaterials, practical deployment still faces challenges. Rapid prototyping is lacking to produce scalable and customizable e-textiles. To meet large-scale batch production and high-resolution electrode line width requirements, as well as long-term durability, new platform technologies have been established to convert existing textiles into multi-functional e-textiles. These studies have also uncovered the process-structure-property relationships of various e-textiles.

In the first study, we present a dual-regime spray technique that writes functional nanoparticles directly onto commercial 4-way stretchable textiles up to a meter scale with high resolution mask-free patterning. The resulting e-textiles retain the intrinsic properties of the fabric and fit various body shapes for high-fidelity recording of physiological and electrophysiological signals under ambulatory conditions. Field tests demonstrate the potential of these e-textiles for remote telehealth monitoring of large animals in a minimally obtrusive manner.

In the second study, we introduce an in-situ polymerization and patterning technique using the dual-regime spray method to synthesize conductive polymers directly on commercial stretch textiles. The resulting e-textiles are used for strain sensors that fit tightly to the human body, providing superior measurement accuracy and fidelity in capturing physical signals and motion detections.

In the last study, we fabricate electroluminescent fibers and transparent conductive threads using a continuous thread maker. These enable the manufacturing of programmable control of pixel arrays with high-reliability textile displays that retain reliable luminescent properties and low power consumption. Field tests demonstrate the uniformity and control of electroluminescent pixels to inform the level of impact severity and incident directions on a helmet.

Date: Thursday, March 30, 2023
Time: 3:30 P.M.
Place: HAMP 2113 or via Zoom, https://purdue-edu.zoom.us/my/chihwanlee

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