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Friday, November 8, 2024
11:15 am ITE 336
(Refreshments in ITE 301 at 11 am)

Carbon-based Inks and Printing Processes for Environmentally Friendly Sensors and Transistors

Dr. Brittany Smith

Abstract:
The semiconductor industry currently fabricates electronic devices using materials that are difficult to recycle and energy-intensive processes with significant waste products, resulting in considerable environmental impact. These processes and materials also limit electronics to rigid substrates, which are not compatible with many emerging applications including wearable healthcare monitors. Additive manufacturing, notably printing, could be a powerful tool for fabricating robust flexible electronics through the use of energy-efficient processes and recyclable or biodegradable materials. In this talk, I will introduce our efforts on printed water-based nanomaterials and use of a novel print process to reduce processing waste. We have established low-temperature, water-only print processes on an aerosol jet printer (AJP) for each component of a carbon nanotube thin-film transistor (CNT-TFT) without compromising on device performance. This work included exploring aqueous high work function metal contacts and nanocellulose gate dielectrics for CNT-TFTs. Additionally, we developed a printing process on a capillary flow printer (CFP) to realize sub-micron transistor channel lengths and thin, well-defined CNT channel widths without the need for cleanroom processing or producing excess material waste. We also established a print procedure to create recyclable 3D graphene microstructures that are conductive without post-processing. We discovered that adding free-standing 3D current pathways parallel to the sensing surface, such as graphene trusses, improves humidity sensor sensitivity by at least 2x. Overall, this work marks a significant leap in the development of sustainable electronics and printing processes.

Bio:
Brittany N. Smith is currently a Postdoctoral Associate at Duke University in Electrical and Computer Engineering in the Franklin Group. She received her B.S.E degree from the University of Connecticut in 2020 and Ph.D. degree from Duke University in July 2024. During her time at Duke, Brittany's research focused on novel nanomaterial inks and print processing for sustainable electronic devices. She has mentored 11 students in the lab, co-authored 12 journal papers, presented her work at 6 conferences, and has taken part in 5 future faculty workshops. Brittany is the recipient of the NSF Graduate Research Fellowship

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