High-rate Nanoscale Printing for Electronics, Sensors, Energy and Functional Materials Applications

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Abstract: Printing offers an excellent approach to making structures and devices using nanomaterials, however, current electronics and 3D printing using inkjet technology, used for printing low-end electronics are slow and provide only micro-scale resolution. The NSF Center for High-rate Nanomanufacturing (CHN) has developed a new fully automated system that uses directed assembly based printing at the nanoscale to make products that fully take advantage of the superior properties of nanomaterials. The Nanoscale Offset Printing System (NanoOPS) can print metals, insulators and semiconductors (including Si and III-V), organic and inorganic materials into nanoscale structures and circuits (down to 20 nanometers). The fully automated robotic cluster tool system prints at the nanoscale to make products that take full advantage of the superior properties of nanomaterials. The NanoOPS has been used to print utilizing the following nanomaterials: nanoparticles, nanotubes, nanowires, 2D materials and polymers. The center has many applications where the technology has been demonstrated. The center has developed many sensors, among them a biosensor chip (0.02 mm) capable of detecting multiple biomarkers simultaneously (in vitro and in vivo) with a detection limit that's 200 times lower than current technology. In addition, the center made a printed Band-Aid sensor that could read glucose, urea and lactate levels using sweat. An inexpensive micro chemical sensor with a low detection limit that's less than 1 mm in size has also been developed. The center has also 2D and 1D materials transistors and inverters and a CNT battery that can be fully charged in a few minutes and retain more 90% capacity.

Biography: Ahmed A. Busnaina, Ph.D. is the William Lincoln Smith Chair Professor, Distinguished University Professor and founding Director of National Science Foundation's Nanoscale Science and Engineering Center for High-rate Nanomanufacturing and the NSF Center for Nano and Micro-contamination Control at Northeastern University, Boston, MA. Prof. Busnaina is internationally recognized for his work on nano and micro scale defects mitigation and removal in micro and nanofabrication. He specializes in directed assembly of nanoelements and in the nanomanufacturing of micro and nanoscale devices. He developed many manufacturing techniques for nanomaterials based energy, electronics, biomedical and materials applications. His research support exceeds $50 million. He authored more than 600 papers in journals, proceedings and conferences in addition to 25 filed and awarded patents. He is an associate editor of the Journal of Nanoparticle Research. He also serves on many advisory boards including Samsung Electronics, International Technology Roadmap for Semiconductors, Journal of Particulate Science and Technology, Journal of Environmental Sciences, Journal of Advanced Applications in Contamination Control. He is a fellow of the American Society of Mechanical Engineers, and the Adhesion Society, a Fulbright Senior Scholar and listed in Who's Who in the World.