Continuous Manufacturing of Carbon Nanotube Forests

Despite the rapidly growing commercial interest in carbon nanotubes (CNTs) and their applications, manufacturing of organized assemblies of CNTs, which retain promise to have exceptional bulk properties, largely remains an unmet challenge. I will present our research on efficient and scalable manufacturing of CNT forests, which connects fundamental growth insights to precision machine design. Synchrotron X-ray scattering is used to reveal the collective mechanism of CNT self-organization into vertically aligned "forests", and to build populatio-based models of mechanical and chemical coupling during growth. Insights from this work have enabled the design of a novel concentric tube reactor for efficient multi-zone roll-to-roll CVD on flexible substrates, and the adaptation of laser printing for-large-scale patterning of nanoparticle toner as a CNT growth catalyst. Applications under development include highstrength CNT foams, active surfaces using 3D CNT microstructures, and digitally engineered fibers assembled from millimeter-long CNTs.

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A. John Hart is currently an Assistant Professor at the University of Michigan, Ann Arbor and will join the MIT faculty in June 2013. John completed his PhD thesis, "Chemical, Mechanical and Thermal Control of Substrate-Bound Carbon Nanotube Growth", at MIT in 2006. At Michigan, John's research has primarily focused on robust, rapid and controllable processing of nanostructured materials and the development of novel manufacturing processes that take advantage of scale-dependent phenomena. His work has been comprehensive and well recognized. John has received several prestigious awards including two R&D 100 awards (2008, 2009), the DARPA Young Faculty Award (2008), the ASME Pi Tau Sigma Gold Medal (2009), the Society of Manufacturing Engineers Outstanding Young Manufacturing Engineer Award (2010), the AFOSR Young Investigator Program (YIP) Award (2011), the NSF CAREER Award (2012), and the ONR YIP Award (2012). At Michigan, John's teaching activities have been in the areas of Design and Manufacturing where he revamped and led the introductory undergraduate course (ME250) and introduced new graduate courses on nanomanufacturing and research methods.

