

Three Dimensional Nanomanufacturing: A Report on the NSF Workshop and activities at the New England Nanomanufacturing Center for Enabling Tools (NENCET)

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The presentation will report the conclusion of the a two-day workshop served as a forum between industry, small business, and academia to address approaches to overcoming nanomanufacturing barriers and challenges. Invited experts from industry provided input and perspective to NSF on current nanomanufacturing research and challenges. Over 100 experts and grantees from small business and academia gathered for this workshop to advise NSF on research needs for the future. The workshop concluded that nanomanufactured commercial products are entering the marketplace. New processes are being developed or must be developed to manufacture nano-scale products. The barriers are both technical and cultural, with many fundamental questions still unanswered, a lack of manufacturing infrastructure, and a need to educate the workforce for and about nanomanufacturing. Success rates can be improved by better collaboration between industry and academe and more funding.

The New England Nanomanufacturing Center for Enabling Tools (NENCET) - a joint effort between Northeastern University (NEU), the University of Massachusetts Lowell (UML), and the University of New Hampshire (UNH) – has focused its research toward the development of fundamental understanding and novel technology in high rate, high volume integration and assembly of robust systems linking the nano and micro/macro scales. Unlike conventional microelectronics, in which the active devices are first fabricated and then interconnected, the sheer complexity of nanoscale systems will require some degree of controlled self-assembly. The center *bridges the gap between ongoing nanoscience research and the creation of commercial products* for both established and emerging industries by focusing on molecular assembly and manufacturing. The proposed research focuses on creating nanomanufacturing tools such as molecular templates, reliability testbeds, nanoscale process models and other tools that will enable industry to overcome the nanomanufacturing barriers. Examples would be processes for guided self-assembly for reel-to-reel manufacturing of SWNT, organic nano-transistors or other nano-elements and MEMs test devices for accelerated-life testing of devices, biosensors and nanostructures. The center strives to address fundamental but also uniquely manufacturing-oriented issues of:

- (1) Smart tooling (guided self-assembly using molecular templates) and wiring,
- (2) Reliability and Testina. and (3) High-rate/high-volume processing.

