Apparatus and Methods for Controlled Growth and Assembly of Nanostructures
Technology #11959

Applications
This technology supports the development of methods for large-scale production of advanced composites capable of reproducing the superior physical properties of aligned nanostructures currently only observed at the laboratory scale. These high performance composites have applications in many areas including the aerospace and automotive industries.

Problem Addressed
Nanostructures such as carbon nanotubes (CNTs) have been the source of much excitement thanks to their exceptional material properties. For example, CNTs have 10-500 times the strength-to-weight ratio of steel and are extremely flexible. However, commercially viable macroscale materials incorporating such nanostructures have yet to be developed, due in large part to challenges in producing bulk quantities of CNT in forms that replicate the properties of individual CNTs. Existing methods of growing bulk CNTs produce tangled, bundled, or agglomerated nanotubes with inferior mechanical properties at unfeasible costs. Producing aligned CNTs at macroscale lengths requires close monitoring and control of growth conditions. This invention provides a method for rapid real-time feedback control of CNT growth process variables.

Technology
This technology monitors vapor-liquid-solid (VLS) nanostructure growth processes (e.g. chemical vapor deposition) using in-situ measurement techniques such as optical measurement, Raman spectroscopy, and X-ray diffraction. This data forms the basis of real-time feedback control of the nanostructure growth process. Chemical and mechanical control inputs are used simultaneously to manipulate process variables including temperatures, forces, and flows. In one instance, mechanical force is applied to the nascent nanostructures during the growth process to induce assembly into desired configurations such as fibers. Reliable self-assembly of nanostructures into ordered and aligned rather than random or tangled configurations is critical to the reproducing the desirable characteristics of nanostructures such as CNTs at macroscopic scales.

Advantages
- Provides simultaneous real-time chemical and mechanical feedback control of nanostructure growth process
- Enables assembly of nanostructures into ordered and/or aligned configurations

Categories For This Invention:
- Materials
- Micro & Nanotech
- MEMS/NEMS (Materials)
- Mechanics

255 Main Street, room NE 18-501
Cambridge, MA 02142-1601
Phone: 617-253-6966 Fax: 617-258-6790
http://tlo.mit.edu
Contact the Technology Manager: tlo-inquiries@mit.edu
Intellectual Property:
Apparatus and methods for controlled growth and assembly of nanostructures
Issued US Patent
8,372,470

Inventors:
John Hart
Lucas Van Laake
Alexander Slocum

External Links:
Mechanosynthesis Group
http://mechanosynthesis.mit.edu/
Precision Engineering Research Group
http://pergatory.mit.edu/

Image Gallery: