

DESIGN, FABRICATION AND PROPERTIES OF
NOVEL ARCHITECTURES MADE FROM CARBON
NANOTUBES AND NANO-POROUS MATERIALS

by

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ABSTRACT

Nanomaterials like carbon nanotubes (CNT) have numerous potential applications due to their unique electrical, thermal and mechanical properties. Building macroscopic architectures using these nanocomponents requires new approaches for organization or assembly of these components. This can be achieved by using various techniques like capillary-induced compaction, template-assisted growth and other synthesis techniques.

The vertically aligned multiwalled carbon nanotube arrays were grown using chemical vapor deposition (CVD). Evaporation of liquid from such vertically aligned nanotube arrays induces the assembly of nanotubes into cellular patterns. The role of substrate and orientation of the carbon nanotube array was investigated and analyzed to gain more control over the pattern formation that could help in designing new structures. Electrical measurements on the CNT patterns before and after capillary-induced compaction revealed that compaction results in four-fold increase in electrical conductivity, making them a potential candidate for vertical interconnects.

A new method to fabricate a syringe with nanopores by using anodization technique was demonstrated. Experimental parameters were investigated to control the dimension and morphology of the nanopores in the syringe. Capillary force was used to infiltrate and replicate the complete 3D architecture into polymers. The usefulness of syringe as a biological sampler (DNA-RNA separation) was demonstrated.

Layered structure of exfoliated mica was used as a substrate for growth of CNTs. This resulted in novel layered hybrid architecture of mica and carbon nanotube arrays. Mechanical properties of such architectures were investigated. Such architectures could be very useful as foams.

These simple techniques can be used to assemble nanoscale components into well-defined macroscopic architectures and thus broaden the range of applications where their unique properties can be put into use.