

## Preparation of Buckypaper, NanoLab's carbon nanotube paper

In 2002, NanoLab developed a process for the production of freestanding carbon nanotube paper, "buckypaper." Using our process, we have made buckypapers from MWNT, DWNT and SWNT. To make the carbon nanotubes amenable to aqueous processing, they need to be first purified and mildly functionalized. Purification of our carbon nanotubes takes place in hydrochloric acid (HCl) to dissolve residual catalyst iron particles. The addition of nitric acid to the etch increases the effectiveness of the purification, and adds carboxylic acid groups to the nanotube surface. Once the nanotubes have been acid treated and washed with DI water until they are neutralized, the material is filtered, dried, and reground into a powder.

Buckypaper preparation requires the suspension of purified nanotubes in deionized water, using our Nanospense AQ surfactant. After sonication, we obtain a nanotube suspension that is stable for months at a time without settling. A volume of this suspension is poured into a filtration unit, and pressurized to push the suspension through a filter. Nanotubes deposit on the filter surface, and this rapidly turns into a continuous nanotube sheet, as shown in Fig. 1. The volume of suspension and its concentration dictates the resulting thickness of the paper. After deposition, the nanotube paper is removed from the supporting filter membrane, leaving a free-standing paper, as large as 8 X 10", weighing ~0.7g. Other standard sizes are 40 mm and 125 mm diameter.

Free-standing papers are typically ~100 microns in thickness. Thinner papers (<50 micron) are difficult to remove from the filter support, although very long (>50 micron) carbon nanotubes make thinner free-standing papers possible. The process makes a porous buckypaper that can be tailored by changing the deposition parameters. Our typical MWNT buckypaper product is ~50% dense, and the replacement of the water base for ethanol results in lower density ~25%. Despite the low density of these ethanol-based papers, our testing shows that they exclude the passage of colloidal particles ~50nm and larger. Mechanically, the paper can be folded, cut with scissors, just as notebook paper, and has similar tensile strength. Thermal and electrical conductivity data is also available on request.

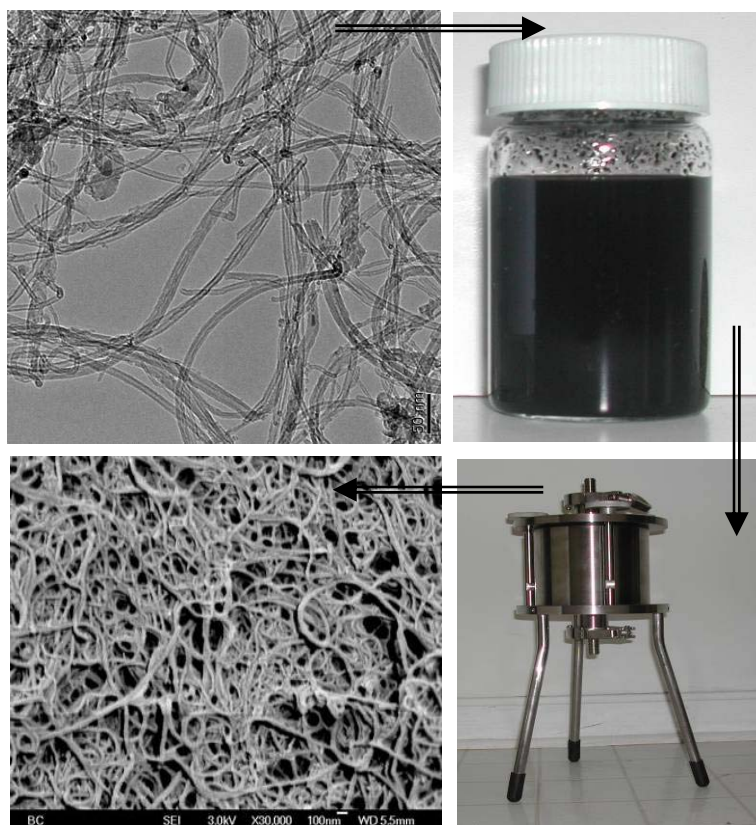


Fig. 1. A suspension is prepared and deposited on a filter to make buckypaper, a 3D network of nanotubes.