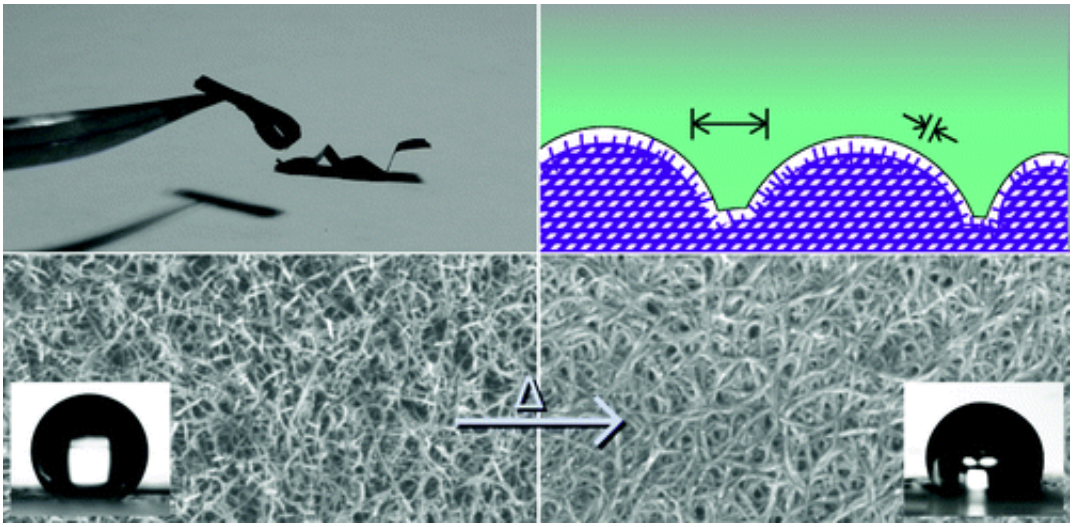
'Shish kebab' structure provides improved form of 'buckypaper'

February 8 2012



Scientists are reporting development of a new form of buckypaper, which eliminates a major drawback of these sheets of carbon nanotubes -- 50,000 times thinner than a human hair, 10 times lighter than steel, but up to 250 times stronger -- with potential uses ranging from body armor to next-generation batteries. Their report appears in the journal *ACS Nano.*

In the study, Christopher Y. Li, Ph.D., and colleagues explain that there are several ways of making buckypaper, named for Buckminsterfullerene, or carbon 60, which was the basis for the 1996

Nobel Prize in Chemistry and helped spawn the emerging field of nanotechnology. In addition to being extremely strong, buckypaper conducts heat and electricity better than most known materials. Made from the same element as diamonds, the space-age material is formed by depositing a very thin layer of entangled carbon nanotubes to create a fiber mat akin to office paper.

Li and colleagues note that no existing post-processing method allows researchers to increase the size of the tiny holes, or pores, between the carbon nanotubes after they form the buckypaper. Li's group looked for a way to do that and to introduce other substances to buckypapers that could make them more useful in electronics or as sensors.

To control pore size, the team grew single crystals of polymers around the nanotubes. The group describes it as a "shish kebab" structure, where the nanotubes are the skewers and the flat crystals serve as kebabs. After the researchers formed the buckypaper, these crystals held the nanotubes apart. Li demonstrated that the crystals allow researchers to control the pores' sizes and change the buckypapers' conductivities, surface roughness and abilities to shed water.

More information: Polymer Single Crystal-Decorated Superhydrophobic Buckypaper with Controlled Wetting and Conductivity, *ACS Nano*, Article ASAP. DOI: 10.1021/nn203861s

Herein we report fabrication of uniform, free-standing nanohybrid buckypaper with high carbon nanotube (CNT) contents (13–70%) using polymer single crystal-decorated CNTs as the precursor. Polyethylene single crystals were periodically grown on CNT surfaces, forming a nanohybrid shish kebab (NHSK) structure. Vacuum filtering a NHSK suspension led to polymer single crystal-decorated buckypaper (named as NHSK paper) with a wide range of CNT contents and uniform CNT dispersion. Porosity, surface roughness, and conductivity of NHSK

paper can be controlled by tuning the polymer single crystal size. Because of the hierarchical roughness created by intra- and inter-NHSK nanostructure, NHSK paper with controlled kebab size exhibits both superhydrophobicity and high surface water adhesion, which mimics the rose petal effect. We anticipate that this unique NHSK paper can find applications in sensors, electrochemical devices, and coatings.

Provided by American Chemical Society