Carbon nanomaterials fabricated with lipid nanotube templates

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Carbon nanomaterials have recently attracted a great deal of attention in the semiconductor industry due to their unique electrical, optical, thermal, mechanical, and chemical properties. Thus, carbon nanomaterials have gained importance in biology for applications such as biosensors and drug delivery. There is a growing interest in the use of self-assembled bioorganic templates in the fabrication of such one-dimensional carbon nanostructures.

The lipid 1,2-dioleoyl-sn-glycero-3-phosphoethanolamine (DOPE) which is the main component of bacterial cell membranes is known to self-assemble into single-wall synthetic lipid nanotubes (LNTs) on polyelectrolyte-functionalized surfaces.[1] We have demonstrated a high-throughput approach to transform these LNTs into surface attached carbon nanostructures through pyrolysis. First, biotin-tagged DOPE LNTs are formed from lipid blocks in inverted hexagonal phase adsorbed on polymer-coated surfaces upon application of shear force and cross-linked by chemical fixation.[2] Samples were dried and treated with high temperature under inert atmosphere to form connected carbon nanostructures. The created carbon nanostructures were characterized by transmission electron microscopy, atomic force microscopy and electrical measurements. The method is advantageous because the small size of LNTs enables the fabrication of surface attached mesh-like nanostructures with a higher throughput without using expensive electron beam lithography. The approach can further be combined with single LNT patterning with a micromanipulator to create distinct patterns instead of random networks.

References

[1] Sugihara et al. (2012) *ACS Nano* **6**, 6626-6632
[2] Jajcevic et al. (2016) *Small* **12**, 4830-4836

Figures

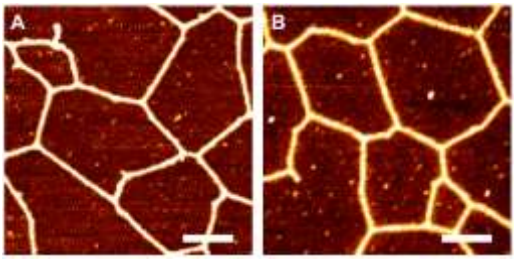

Figure 1. TEM images of surface attached LNTs before (A) and after (B) pyrolysis under inert atmosphere. Scale bars are 500 nm.