**A Combined IR, Raman and STM Study on the Structure of All-fullerene Core Self-organized Nanorods**

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Self-organization is expected to play an important role in the development of nanotechnology since conventional micro-scale device preparation methods become both technically difficult and cost-ineffective when one attempts to apply them on the nanometer scale. Because of their ability to form nanophases of controlled shape and size, fullerene derivatives are extensively studied in this respect. We have recently reported the synthesis[1] of a $C_{60}$-fullerid (depicted in Fig. 1) which self-assembles into rodlike structures $d$=10-30 nm in diameter and $l$>1000 nm in length[2] (Fig. 2) when dissolved in water.

In this contribution we present a complete characterization of the nanorods both at the molecular (IR and Raman spectroscopy) and at the supramolecular (STM) level. Characteristic differences in the vibrational spectra make it possible to distinguish between unfunctionalized $C_{60}$, bulk phase precursor salt and self-assembled nanorod. Our most interesting STM result is that unlike the self-assembled vesicles[3], foams[4] and cylinders[5] of previously reported fullerids, our nanorods are not made up of an amphoteric bilayer surrounded by solvent molecules on both sides. Rather, the rodlike objects appear to be bundles of much thinner individual sticks which possess an all-fullerene core. Thus, the rodlike objects are formed by double self-organization: the precursor salt first self-assembles into thin ($d$=2-3 nm) sticks and then several sticks stack together to make a rod. We were able to obtain atomic resolution STM images of the individual nanosticks and propose a full geometry model for the arrangement of the fullerids within. The thermal stability of the nanorods was also studied and found to be unexpectedly large, indicating that the fullerenes may undergo a cycloadditive polymerization reaction at elevated temperatures.

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**References**

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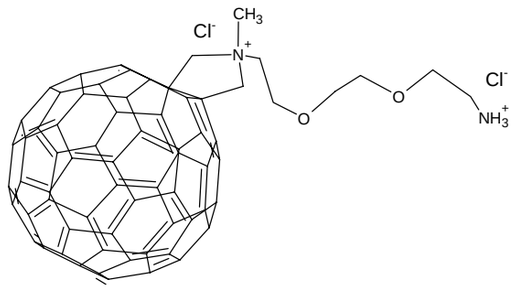


Fig. 1. Structure of the nanorod precursor salt.

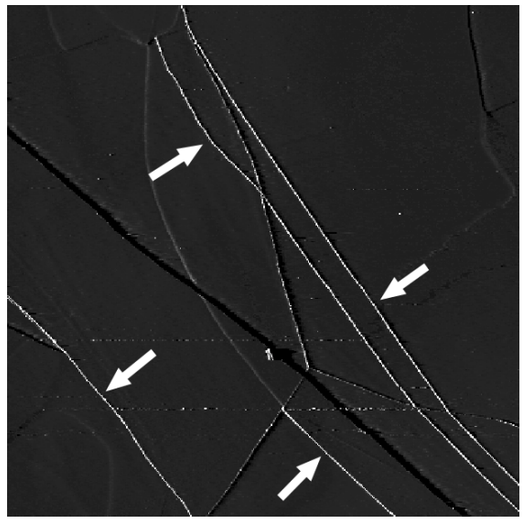

Fig. 2. A 2 μm × 2 μm STM image showing self-assembled nanorod bundles (indicated by white arrows) on HOPG. The bundles are 15-20 nm in diameter and are made up of several thinner, all-fullerene core nanosticks.