Materials Inside Single-Walled Carbon Nanotubes: The World's Smallest Crystals

Malcolm L. H. Green, Jeremy Sloan, and Angus I. Kirkland
University of Oxford, United Kingdom

Crystal growth within single-walled carbon nanotubes (SWNTs) is atomically regulated and nanoscale crystals with precise integral layer architectures (*i.e.* "Feynman crystals") are formed. The structural properties of the resulting 1D crystals are often related to the structural chemistry of the same material in the bulk, but they exhibit substantial lattice distortions compared with the corresponding bulk material. Further, in the smallest crystals most, sometimes all, the atoms lie on the surface (see Fig. 1). In some cases, 1D crystals with completely novel structures are formed inside SWNTs. In short, all the physical properties of material with familiar stoichiometry will be different from those of the same materials in the bulk form. It is clear that it will be possible to insert a vast range of materials inside SWNTs. In many cases precise structural characterisation using TEM can be achieved. Now is the time to dream of possible applications of these remarkable nanosystems.

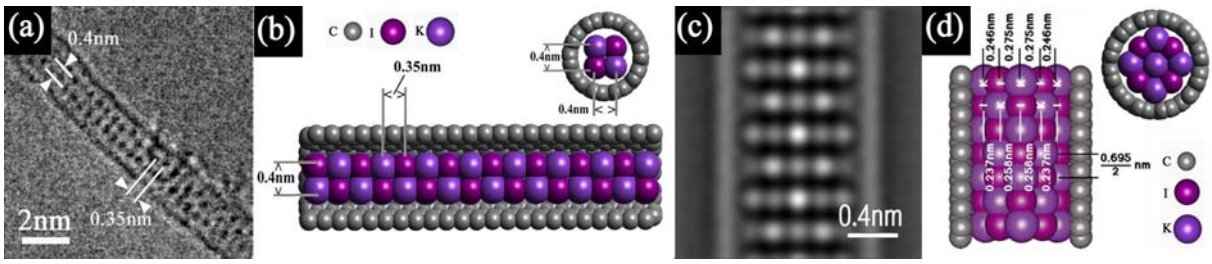

FIG. 1: (a) HRTEM image of a 2×2 KI crystal in a 1.4 nm diameter SWNT; (b) structural representation of (a) (inset: end-on view); (c) reconstructed image of a 3×3 KI crystal in a 1.6 nm SWNT; (d) structural representation of (c) (inset: end-on view).