13-Defects, Microstructures and Textures

13.01 - Electron Microscopy of Defects, Microstructures and Textures

MS-13.01.02 STRUCTURAL STUDY OF CARBON NANOTUBES
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This talk covers an introduction of carbon nanotubes which we discovered (Iijima, Nature, 354, 56 (1991)), and some latest developments in nanotube studies. The materials draw much attention among many solid state scientists in physics, chemistry, and materials science in various aspects because of their unusual size dependent properties. The tubules, studied by HRTEM and electron microdiffraction, are only a less than a few nanometers in diameter, and each needle consists of a few nesting cylinders of graphic sheets. On each graphitic tube the carbon atom hexagons form in a helical fashion about the needle axis. Electron diffraction patterns taken from individual nano-scale tubules are a main technique available for the structural studies. The technique was extended to observe single cylinder tubules with a diameter of around one nanometer. It emphasizes that we deal with electron scattering from a single atomic sheet with a nano-scale size.

Tubule morphologies were affected by occurrence of pentagons and heptagons in the hexagon sheet tubes (Iijima et al., Nature, 365, 776 (1992)). The latter introduces negative gaussian curvature into a hexagon sheet network and causes various graphitic structures (Mackay & Tonnessen, Nature, 352, 762 (1991)). Non-hexagon rings play an important role in tubule growth and lead us to propose an open-end growth mechanism (Iijima, et al. Phys. Rev. Lett. 69, 3100 (1992)).

Other subjects include oxidation and capillarity of the nanotubes (Ajayan & Iijima, Nature, 361, 333 (1993)) which provide interesting crystallographic problems occurring specifically in a nanospace.

MS-13.01.03 HYDROGEN STUDY OF APPRECIANT SOLIDS RELATED TO THE ARCHIMEDEAN SPIRAL by I. A. Burwell, Feng Li, and Ze Yuan
University of Melbourne Parkville, VIC 3052, Australia.

The concept of spiral lattice was applied to some known mineral structures by Burwell, I. A. Mod. Phys. Rev., 219-221, 1986. These include clino-schistos, bellogite (a clay) and cyllindrite is sulphide.

Further examples of synthetic curves as well as related to normal crystals via conformal transformations, are found in sulphide catalyst particles as well as some derivatives of graphitized carbon, including nanotube variants.

Some recent results of high resolution electron microscopic studies of this family of aperiodic solids are presented.

MS-13.01.04 STRUCTURAL ANALYSIS BY ELECTRON DIFFUSE SCATTERING. By Yingmei Zhu
Materials Science Division, Brookhaven National Laboratory, Upton, New York, USA.

YBa$_2$Cu$_3$O$_y$ superconductors undergo a structural transition (from twin to twinned) when oxygen levels are sufficient depleted or a small fraction of the Cu atoms is replaced by certain tri-