Nanocarbon materials under high pressure

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Nanostructured carbon materials, namely fullerenes and carbon nanotubes, have produced significant excitement in the field of high pressure science in this decade. An important feature of this class of materials is that they have well defined nanostructures as well as free void formed in the assembled solids. These two features provide a large variety of freedom in properties of nanocarbon solids. In this paper, I will describe several peculiar aspects of high pressure behaviours, which are ascribed to the freedom in fullerene and carbon nanotube solids.

Pressure-induced intermolecular bond switching was discovered more than ten years ago, and this phenomenon produced a large variety of polymeric forms of fullerenes [1]. Nowadays, one-, two-, and three-dimensionaly polymerized C_{60} have been isolated, as well as dimers C_{120}. Furthermore, *in-situ* x-ray diffraction experiments uncovered the reaction process from the two-dimensional tetragonal polymer of C_{60} to a three-dimensional polymer *via.* a first-order irreversible transformation at P = 24 GPa [2].

Intercalated fullerides also display rich variety of phase transitions at high pressure. Particularly, the covalent bonds between intercalated metals and carbon atoms cause unique structural changes in rare earth doped fullerides. A pressure-induced orientational transition associated with the change of bonding nature will be presented in the rare-earth doped fullerides $Sm_{2.7}C_{70}$ [3].

Finally, the high pressure behaviour of double walled carbon nanotubes (DWNT) is reported. A Raman experiment showed that the outer tubes act as a protection shield of pressure for the inner tubes, whereas the latter increase the structural stability of the outer tubes upon pressure application [4].

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[3] Dam H. Chi et al., Phys. Rev. B 67, 094101 (2003)

[4] J. Arvanitidis et al., Phys. Rev. B 71, 125404 (2005).