10-Physical and Chemical Properties of Materials in Relation to Structure (Superconductors, Fullerenes, etc)

In contrast to a well-known fcc $\text{Ca}$ crystal, a relatively large single crystal (0.1 x 0.5 x 5mm$^3$) with an orthorhombic lattice, was successfully grown from Cs$_2$ solution(Kikuchi et al.,1991). Its structure was tentatively assigned to the space group Pnm by its lattice constants a=24.99, b=25.60, c=10.00 A (Z=8) under an ambient condition. In order to study its structural aspects under hydrostatic pressure, we have carried out x-ray diffraction experiments by using a diamond-anvil cell on both conventional laboratory source and synchrotron radiation source of the Photon Factory. With increasing pressure, we have discovered a phase transition from orthorhombic to monoclinic lattices between 1.1 and 2.2GPa at room temperature. Upon the transition, the orthorhombic c-axis inclines in the ac plane by an angle of 0.55deg, while other principal axes are retained. The pressure dependence of its unit cell volume (bulk compression) does not show appreciable discontinuity across the transition pressure and it is fitted by the Birch-Murnaghan equation of state resulting in its bulk modulus $K_0=10.5+1.9$GPa. This is contrast to the value of the fcc crystal ($K_0=18.1$ GPa) (Dueck et al.,1991), showing that the orthorhombic crystal is much more compressible than the fcc one. However, we have not succeeded in obtaining information of molecular displacements associated with the transition.

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PS-10.02.09 FORMATION OF CARBON NANOTUBES BY THE EXPLOSION OF CARBON ROD CONTAINING $\text{Sc}$:O. By Asato GIKASHI1, Yoshinori ANDO1, Department of Physics, Meijo University, Tempaku-ku, Nagoya 468, Japan; Shuji BANDO1, Inst. Nuclei. Sci., Toyohashi, 444, Japan and Takashi SAITO1, Meijo University, Toyama, 444, Japan.

Gas evaporation method using dc arc-discharge has been applied to form fullerenes, i.e. carbon 60 and relatives. When the fullerenes are formed by this method, carbonaceous deposits are formed onto the tip of negative electrode. It is well known that there exist carbon nanotubes and fullerenes in the deposits (Shimobayashi et al., Nature, 1992, 357, 52.). Here, we carried out arc-discharge by the use of carbon rods containing Sc$_2$O$_3$ on the positive electrode, and observed by high resolution SEM carbon nanotubes and nanoparticles growing in the carbonaceous deposits. From the result, we discuss Sc effect on the growth of the tube.

On the negative electrode side, the high purity graphite rod of 10mm was used. On the other hand, three kinds of carbon rods (containing $\text{Sc}$$_2$O$_3$ pitch, containing pitch only and pure graphite containing nothing) were used on the positive electrode to compare difference of the nanotube growth brought about by composition of original carbon rod. The atmospheric gas used in the experiment was helium gas of 50 Torr. $\text{Sc}$ arc electric current was varied in the range from 180A to 260A. The deposits formed by this evaporation were cut by diamond saw, and the cross section was observed by SEM.

The feature of nanotubes in the deposit formed by evaporation of a rod containing $\text{Sc}$$_2$O$_3$ and pitch is shown in Fig. 1. The amount of nanotubes is tremendous. Many nanotubes with same diameter are bundled together to form long wavy fibres. On the other hand, in the case of rods without $\text{Sc}$$_2$O$_3$, the nanotubes are straight and not so bundled. Also, many more nanoparticles than bundles are observed in this case. From these observations, it became clear that Sc had a great effect on the growth of nanotubes.