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Nanocarbon Thin Films Prepared at Room Temperature by Synchrotron-Radiation-Stimulated Photochemical Reaction

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Nanocarbon such as fullerene and carbon nanotube has become one of the most interesting materials for use in advanced nanotechnology devices. In the nanocarbon thin-film preparation process, it is necessary to have a low deposition temperature for realizing low-cost and low-melting-point glass substrates. Synchrotron-radiation-stimulated photochemical reactions enable the preparation of various crystalline thin films at room temperature beyond the low-temperature limit of conventional thermal reactions. The compact synchrotron light source located at Ritsumeikan University emits a high-brilliance light covering the energy range from soft X-rays to vacuum ultraviolet light. The light having this energy range irradiated from the synchrotron light source can excite the inner-shell electrons of materials. Inner-shell electron excitation creates many localized holes in the valence orbital and results in the Coulomb explosion of materials. As a result, these materials are reduced to fragments. These thus-obtained fragments were deposited onto a substrate facing the target. This process, which is called synchrotron radiation ablation, is applicable to nanocarbon thin-film preparation at room temperature. Deposition of fullerene C_{60} and single-walled carbon nanotubes (SWNTs) was carried out individually on a Si substrate or a quartz substrate using powder state targets. A high-quality crystalline fullerene C_{60} film was obtained despite the fact that the film was deposited at room temperature. The deposition rate of SWNTs was only 10nm/h, which is only one-three hundredths that of fullerene C_{60} . The difference in the ablation mechanism between the SWNTs and fullerene C_{60} was considered. The C-C bond with an sp^3 hybridized orbital in a normal chain, for example, of polyethylene is easily broken after synchrotron irradiation. The structures of SWNTs and fullerene C_{60} are based on the carbon cyclic structure with an sp^2 hybridized orbital. In the carbon cyclic structure, the π electron is delocalized. The energy randomization process is more rapid rather than the fragmentation process in the carbon cyclic structure. Thus, the possibility of breakage of the C-C bonds in the carbon cyclic structure after synchrotron irradiation is low. However, individual C_{60} unit are bonded not only by van der Waals force but also by the electrostatic force in the fullerene crystal. The bonds between individual C_{60} unit are broken after synchrotron irradiation. The fragments from the fullerene target following synchrotron irradiation consist not of individual C ions but of ionized C_{60} and some cluster ions of C_{60} . The SWNTs have structures consisting of two or more concentric shells of carbon sheets. The diameters of some SWNTs range between several and several decades nanometer, whereas the lengths are longer than several micrometer. It is estimated that the SWNTs are too large to fragment. Thus the deposition rate of SWNTs is very low.

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Synthesis And Crystal Structural of Two Metal-3,4 Xylidinium Cyclohexaphosphates

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Hybrid organic-inorganic materials have been increasingly studied over the last several years for their interesting structural and potential uses in various fields such as catalysis, biomolecular sciences and nonlinear optics [1-3]. In the present work, we report the synthesis and the X-ray structure determination of two new organic-metal cyclohexaphosphates:

- $Cd[3,4-(CH_3)_2C_6H_5NH_3]_4P_6O_{18} \cdot 6H_2O$ which crystallizes in P-1 triclinic unit-cell with $a = 7.773(4) \text{ \AA}$, $b = 9.238(3) \text{ \AA}$, $c = 18.532(7) \text{ \AA}$, $\alpha = 88.10(4)^\circ$, $\beta = 88.57(3)^\circ$, $\gamma = 67.35(4)^\circ$, $V = 1227(1) \text{ \AA}^3$ and $Z = 1$.

- $Nd(P_6O_{18})_2[3,4-(CH_3)_2C_6H_5NH_3]_9 \cdot 2H_2O$ which is orthorhombic Pbc_a with the following unit-cell parameters: $a = 14.6751(6) \text{ \AA}$, $b = 35.327(1) \text{ \AA}$, $c = 38.635(2) \text{ \AA}$, $V = 20030(1) \text{ \AA}^3$ and $Z = 8$.

Their different atomic arrangements can be described as a layer organization built of P_6O_{18} ring, metal polyhedra and water molecules. Between these layers, the organic groups, 3,4-xylidinium, are located to form so a three-dimensional network, involving different interaction types. Some striking disparities are observed in these structures in spite of their same components. In particular, the voluminous unit-cell and the big interdistance observed for the Nd salt are exceptional in the phosphate field.

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