

Direct observation of iodine-doped C₆₀ crystal by scanning transmission electron microscope

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Structural analysis for iodine-doped C₆₀ crystal has been performed by several methods like x-ray and electron diffractions and transmission electron microscopy. Two possible structures, orthorhombic [1] and hexagonal [2] structures, have been proposed, but the conclusive structure is not clear yet because of the uncertainty of the doped iodine position [3]. In the present work, high resolution annular dark field (ADF) imaging by using a scanning transmission electron microscope (STEM) is applied to determine the position of iodine atoms in C₆₀ thin film. ADF-STEM technique, detecting electrons scattered to high angle, provides the image contrast depending on the atomic number with high spatial resolution, so that heavy atoms like iodine in C₆₀ crystal can be observed directly.

Thin crystal film of C₆₀ was prepared on alkali-halide single crystal substrate kept at 453K by vacuum vapor deposition. The doping of iodine into C₆₀ film was carried out by solid-vapor reaction using a two-cell tube sealed with helium gas kept at 473K for two days. ADF-STEM images were observed using a detection angle of 20 to 53 mrad by an electron microscope (JEM-2200FS) equipped with an omega type of energy filter. The incident electron probe size was less than 0.2 nm in diameter.

The atomic columns of doped iodine are seen very clearly in the observed ADF-STEM images. From the position of iodine atoms relative to the C₆₀ molecular sites in the unit cell it is concluded that the iodine doped C₆₀ crystal has the orthorhombic-like (monoclinic) structure. In the presentation we will discuss the structural transformation due to the iodine doping into the C₆₀ crystal.

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