Letter

Preparation of Fullerene Thin Films by Ion Plating and Transmittance Analysis

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Fullerene thin films were prepared by conventional vacuum evaporation deposition and by ion plating with no bias, +200 V and –200 V bias applied. Weak C_{60} (420) and (664) peaks were detected from X-ray diffraction patterns of all the films. Transmittance spectra showed that the transmittance of all the films was more than 95% in the infrared region, whereas there were some broad absorption spectra at 221, 271, 347 and 476 nm. The shape of the absorption spectra for the films prepared with no bias and –200 V were similar, and weaker and broader than those prepared by evaporation deposition. The spectra for the prepared with +200 V became much weaker and broader.

Keywords: fullerene thin film, ion plating, transmittance, absorption spectra

Thin solid films are of growing interest due to their numerous applications in various scientific, technological and industrial fields, in which they are being different from bulk material application. Fullerene is novel molecular material with a unique spherical cage structure[1]. To date, fullerene films have usually been prepared using a variety of methods, including vacuum evaporation deposition[2][3]. There is no report on their preparation using an ion plating method.

In the present study, fullerene thin films were prepared using an ion plating method with the application of positive and negative biases, as well as by conventional vacuum evaporation deposition, or sublimation deposition. The films were optically analyzed and compared.

Black soot containing fullerenes was prepared with a graphite arc method in He gas of approximately 10 kPa[4]-[7]. The fullerenes were extracted from the black soot by an Soxhlet extractor with toluene solvent, and then dried. The composition of the fullerene powder was approximately as follows, C_{60} : C_{70} : higher fullerenes (C_{76}, C_{78}, C_{82}, C_{84}) = 64 : 28 : 6 wt%[6][7].

The experimental setup for fullerene film preparation is depicted in Fig. 1. 3 mg of fullerene powder was put in the boat for the sublimation metal. The bell jar was evacuated to 0.3×10^{-3} Pa with an oil diffusion pump and a rotary pump. The tungsten (W) wire (0.3 mm in diameter) ring filament was located 75 mm above the boat and was heated at 1,300°C in order to supply a shower of electrons. The boat was heated at 500°C for approximately 10 min. Silicon (Si: 100) (15 mm × 10 mm) and quartz (25 mm × 25 mm) substrates were located 175 mm from the boat.

The crystalline state of the film was analyzed with an X-ray diffraction analyzer (Rigaku, RINT-2500: X-ray source, Cu K_α).

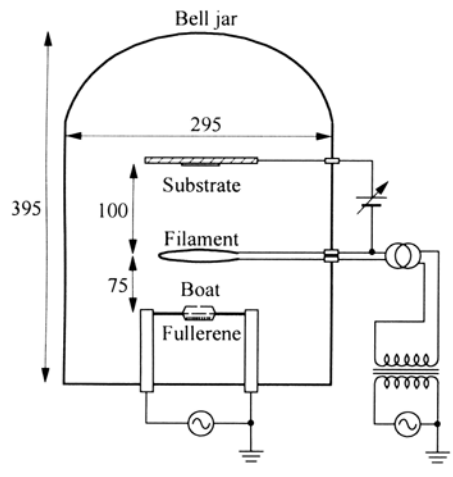
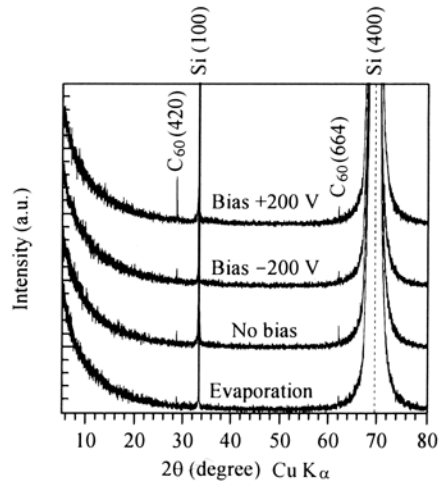


Fig. 1. Experimental setup for ion plating of fullerene.



(Substrate: Silicon (Si: 100))

Fig. 2. X-ray patterns of fullerene films.