Formation of SiC Films Via C_{60} Molecules as a Precursor

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Silicon carbide (SiC) has been regarded as a potential material for applications in optoelectronics, high-temperature semiconducting devices and microelectromechnical systems (MEMS). In the past, chemical vapor deposition (CVD) techniques have been widely used to produce SiC films on the silicon surface. However, these processes for the growth of a good-quality SiC film require the substrate maintained at a temperature as high as 1050 °C, which is a great restrain for the device fabrication. In this article, we discuss the formation of SiC films via C_{60} molecules as a precursor, in particular focusing on C_{60} molecules interacting with the Si(001)-2×1 substrate. High-resolution core-level and valence-band photoemission spectroscopy are employed for this study; meanwhile LEED are also used in the analysis. The high brilliance and tunable characters of synchrotron-radiation light in this study is essential in achieving the needed high resolution and high surface sensitivity. An account is given of how C_{60} molecules combine with Si to form SiC films. The carbonization process of thermal reaction of C_{60} with Si is presented. The surface structure of SiC films formed upon annealing the C_{60}/Si surface is displayed. We then consider the SiC film producing upon deposition of C_{60} onto Si(001) at an elevated temperature of 800 ^{o}C. The formation of β-SiC(001) 2×1 films by this simple and efficiency method have been shown.

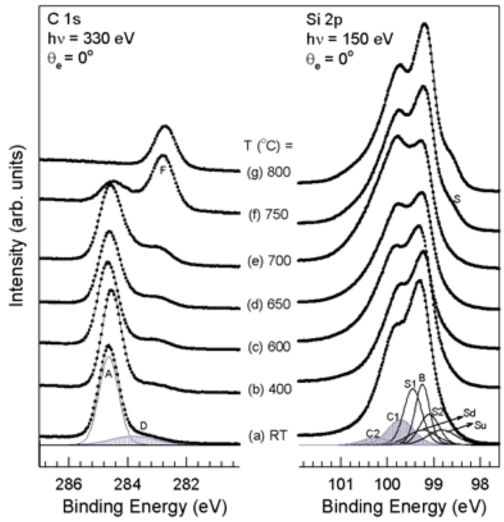

Figure 1. C 1s core-level spectra recorded at a photon energy 330 eV (left panel) and Si 2p core-level spectra at a photon energy 150 eV (right panel) in normal emission for various annealing temperatures, T, on a 0.5-ML C_{60}/Si(001)-2×1 interface. The 0.5-ML C_{60} coverage at RT is displayed in (a). The T/°C are (b) 400, (c) 600, (d) 650, (e) 700, (f) 750, and (g) 800.

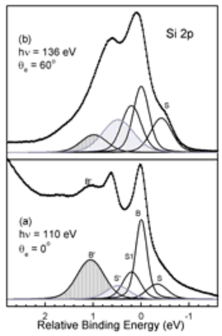

Figure 2. Si 2p core-level spectra for annealing a 0.5-ML C_{60}/Si(001)-2×1 surface at 800 °C. Spectrum (a) is taken in normal emission with a photon energy 110eV, and spectrum (b) is taken at 60° emission with a photon energy 136 eV. The analytical curve-fitting results are also displayed.

Figure 3. C 1s core-level spectra recorded at a photon energy 330 eV in normal emission for C_{60} molecules on a Si(001)-2×1 surface (a) at 800 °C, and (b) at room temperature (RT).

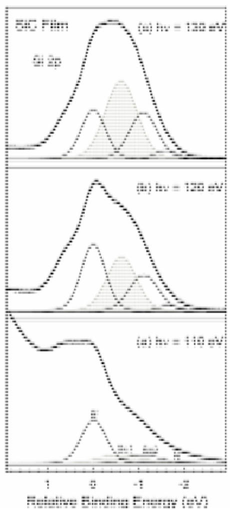

Figure 4. Si 2p core-level spectra of synthesized SiC films taken at various photon energies, hν. The hν/eV is (a) 110, (b) 120, and (c) 130.

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