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Characteristics of the Diamond Thin Film as the SOD Structure

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The diamond films which can be applied to SOD(silicon-on-diamond) structure were deposited on Si(100) substrate using CO/H_2 and CH_4/H_2 source gases by microwave plasma chemical vapor deposition(MPCVD), and SOD structure have been fabricated by poly-silicon film deposited on the diamond/Si(100) structure by low pressure chemical vapor deposition(LPCVD). The phase of the diamond film, surface morphology, and diamond/Si(100) interface were confirmed by X-ray diffraction(XRD), scanning electron microscopy(SEM), atomic force microscopy(AFM), and Raman spectroscopy. The dielectric constant, leakage current and resistivity as a function of temperature in films are investigated by C-V and I-V characteristics and four-point probe method.

The high quality diamond films without amorphous carbon and non-diamond elements were formed on a Si(100), which could be obtained by CO/H_2 and CH_4/H_2 concentration ratio of 15.3 % and 1.5 %, respectively. The (111) plane of diamond films was preferentially grown on the Si(100) substrate. The grain size of the films deposited by CO/H_2 are gradually increased from 26 nm to 36 nm as deposition times increased. The well developed cubo-octahedron 100 structure and triangle shape 111 are mixed together and make smooth and even film surface. The surface roughness of the diamond films deposited by under the condition of CO/H_2 and CH_4/H_2 concentration ratio of 15.3 % and 1.5 % were 1.86 nm and 3.7 nm, respectively, and the diamond/Si(100) interface was uniform and abrupt without voids. The measured dielectric constant, leakage current, breakdown field, and resistivity of the films deposited by CO/H_2 concentration ratio of 15.3 % are obtained 5.3, 1×10^{9} A/cm^2, 1 MV/cm, and 7.2×10^6 Ωcm, respectively. In the case of the films deposited by CH_4/H_2 concentration ratio of 1.5 %, the measured dielectric constant, leakage current, breakdown field, and resistivity are 5.8, 1×10^{9} A/cm^2, 1 MV/cm, and 8.5×10^6 Ωcm, respectively.

In this study, it is known that the diamond films deposited by using CO/H_2 gas mixture as a carbon source are better than these of CH_4/H_2 one.