High Quality Homoepitaxial CVD Diamond for Electronic Devices

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We have successfully synthesized high quality homoepitaxial diamond films with atomically flat surface by the microwave plasma chemical vapor deposition (CVD) using a low CH_4 concentration of CH_4/H_2 gas system and Ib (001) substrate with low-misorientation angle. An atomic force microscopy (AFM) image on the surface of film grown at 0.025% CH_4 concentration have showed that the films have atomically flat over the area as large as 4 × 4 mm^2. These films have shown a strong excitonic emission of 5.27 eV line even at room temperature, while no essential emission lines in the visible light region as well as the band-A emission (2.95 eV) originated from defect-related centers in the cathodoluminescence (CL) spectra. Furthermore, high-quality Schottky junctions between Al and p type high-conductivity layer near the surface of these films have been obtained. Based on this growth method, we have also successfully synthesized B-doped diamond films using trimethylboron [$B(CH_3)_3$, TMB] gas as a B doping source, whose Hall mobility is 1840 cm^2/Vs at 290 K. Schottky junction fabricated by the B-doped diamond also shows excellent performances; a fine diode property with a high breakdown voltage (over 500 V) is realized at more than 200 °C . These results indicate that the homoepitaxial diamond films presented here have a high potentiality for electronic devices.

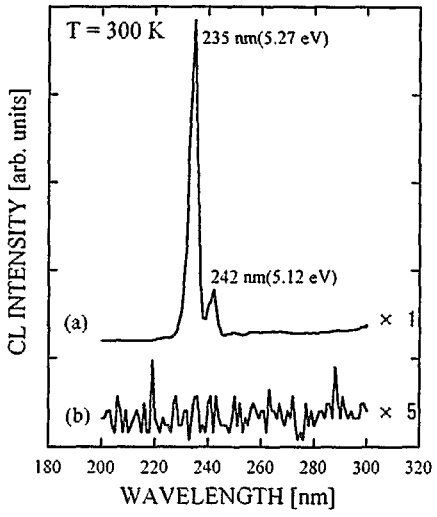

Fig.1. Near-band-edge CL spectra at room temperature, where (a): the spectrum for the CVD diamond film and (b): the Ib diamond substrate.

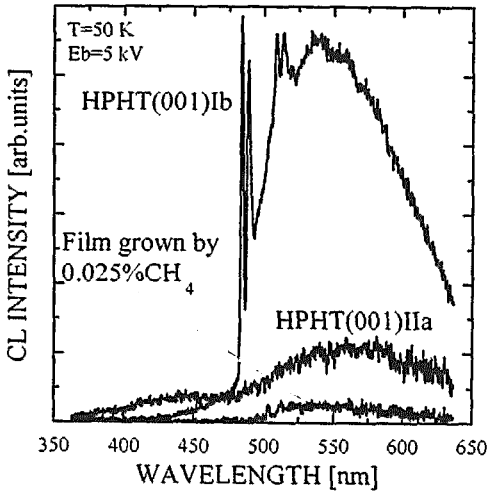

Fig.2. CL spectra in the visible light range for the samples of (a) the Ib diamond substrates, (b) high quality IIa (001) substrate and (c) the film grown at 0.025% CH_4/H_2 ratio.