

§25. Trial of Fast Neutral Particles and Neutron Measurement by a Synthetic Diamond Radiation Detector

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1. Introduction

Synthetic diamond radiation detectors aiming at fast neutral particles and neutron measurement in the LHD will be developed; synthesis of high-quality diamond and their characterization will be included. Energy distribution of fast ion in plasma is able to obtain from energy distribution measurement of fast neutral particles after the charge conversion reaction. In this research this measurement is a main objective. In addition, measurement of neutrons caused by tritium burning, simulating experiment of alpha particles confinement, is waiting as a future plan. This fiscal year, parameter survey in diamond growth condition for a micro-wave assisted plasma chemical vapor deposition (CVD) method was carried out in Hokkaido University.

2 Synthesis of diamond crystals

Homoepitaxial growth of diamond was carried out on high-temperature and high-pressure (HP/HT) type Ib single diamond substrate using an ASTeX AX5250. Table 1 summarize typical growth conditions. Sample #3 had relatively good surface morphology, and then sample #5 was grown in the same condition as sample #3 except lower methane concentration.

As general characterization of crystal qualities, observation of surface by a differential interference microscope and Raman spectroscopy. Then parallel electrodes of TiC/Au ohmic and Al schottky contacts with a interval of 0.3 mm, were fabricated on a surface of a sample for evaluation of charge transport properties.

3. Experimental results and discussions

Growth parameter, i.e. a ratio between growth rate for <100> and <111> direction, were c.a. 1.5 for #1 and #2, between 3 to 5 for #3 and #4. For sample #5 with lower methen concentration it was approximately 2. Figure 1 shows a differential interference image of sample #3. As results, sample #3 and #4 had response to alph particles. Although sample #5 had a sharper Raman peak, the sample looked like polycrystalline and had large leakage current. Further investigation in growth parameter is indispensable.

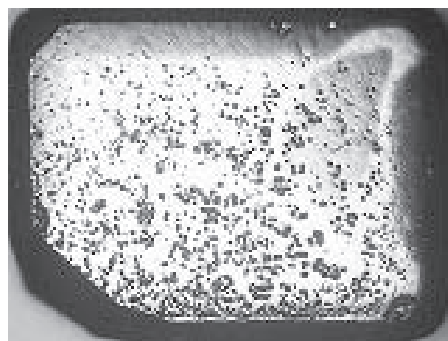


Fig. 1. Differential interference image of sample #3

Table Growth condition and evaluation results

I. D.	Pressure (torr)	Temperature (°C)	Synthesis time (h)	CH ₄ /H ₂ (%)	Growth rate (μm/h)	FWHM (cm ⁻¹) of Raman peak	Response to alpha particles
1	80	1100	24	6	3.42	4.56	×
2	110	1100	24	6	3.75	4.56	×
3	110	800	72	6	2.42	6.15	○
4	80	800	68.2	6	1.67	4.21	○
5	110	800	72	1	0.67	3.84	×