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Development of CVD Diamond Detectors and Performance of Neutron Testing

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This study presents the design and development of the Chemical Vapor Deposit (CVD) diamond detector that applies to detect the neutron radiations. The implementation of a neutron detector in a thin CVD diamond film has several advantages as radiation hardening, fissile-material free, low gamma sensitivity, compact and solid state, spectroscopic, both thermal and fast neutron detection, especially when using external "blankets" to convert the neutrons into detectable charge particles. There are thermal and fast neutron detectors were developed as Gd and Ag neutron detectors, respectively. Beside it, the simultaneous detector was fabricated that can detect both of thermal and fast neutron radiations. Based on the design and calculation, the thin film deposition of Gd and Ag electrodes were determined as 4 μm and 150 nm, respectively. The performance testing to characterize the response of CVD diamond detectors has been carried out at the KIGAMS MC-50 Cyclotron having a 30 MeV proton energy and 10 μA current, which is an accelerator based neutron sources with the high neutron flux about 1x10⁴ ˜1x10⁶ n.cm⁻².s⁻¹. The detector counting efficiency and energy resolution were accordingly derived as a function of the thickness of the 6LiF and CVD diamond layers, both for thermal and fast neutrons, thus allowing us to choose the optimum detector design for any particular application. Comparison with experimental results is also reported.

Keywords: CVD Diamond, Neutron, Radiation Detection.

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