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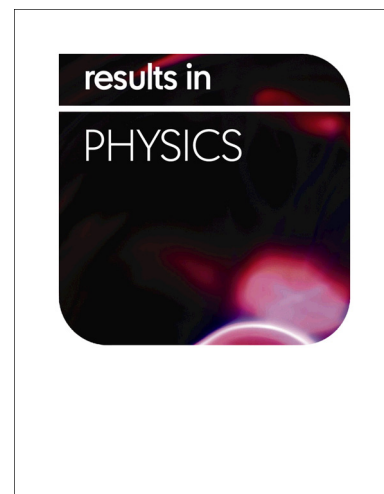
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Comparison of Silicon, Germanium, Gallium Nitride, and Diamond for using as a Detector Material in Experimental High Energy Physics

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Abstract

Semiconductor detectors with Silicon as the sensor material are widely used in High Energy Physics (HEP) experiments for high precision tracking and determination of primary and secondary vertices with good spatial resolution. They are close to the interaction point, so they are prone radiation damage due to the high fluence of produced particles. The choice of semiconductor material is based on the the signal to noise ratio, multiple scattering, pulse timing and radiation hardness. In this paper, we compare the suitability of Silicon (Si), Germanium (Ge), Gallium Nitride (GaN), and Diamond for high energy and high luminosity experiments. In addition, we also show the results on the growth of diamond films and their characterizations.

Keywords: MPCVD, Radiation hardness, Luminosity, Occupancy

1. Introduction

1 Silicon sensors are used in HEP experiments as a pixel, strip and drift detectors
2 [1]. Together they serve the purpose of reconstruction of primary and secondary
3 vertices with good spatial resolution. Pixel sensors form the innermost layers
4 because of high occupancy of particles. In addition, they also provide good
5 signal to noise ratio as their small size, the leakage current and capacitance are
6 also small. As the distance from the vertex increases one has layers of strip and
7 drift detectors enclosing the vertex. Diamond because of its innate properties
8 mentioned later, is increasingly being used such as in experiments like ATLAS,
9 COMET, ITER etc. ATLAS uses diamond pad detector as a beam condition
10 monitor (BCM) [2]. It is also used for the detection of thermal and fast neutrons
11 [3], neutral-particle analyzer at high temperature (ITER experiment) [4], as a
12 beam monitor in COMET experiment [5]. Diamond has also been tested as a
13

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