

Accepted Manuscript

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PII: S0167-577X(17)31665-8
DOI: <https://doi.org/10.1016/j.matlet.2017.11.040>
Reference: MLBLUE 23406

To appear in: *Materials Letters*

Received Date: 2 November 2017
Revised Date: 9 November 2017
Accepted Date: 10 November 2017



Please cite this article as: A. Ashraf Ali, J. Kumar, V. Ramakrishnan, K. Asokan, Raman Spectroscopic study of He Ion Implanted 4H and 6H – SiC, *Materials Letters* (2017), doi: <https://doi.org/10.1016/j.matlet.2017.11.040>

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Raman Spectroscopic study of He Ion Implanted 4H and 6H – SiC

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Abstract:

In the present study, the surface morphology using atomic force microscopy (AFM) and the optical properties by Raman Spectroscopy has been used to understand the modification in the 4H-SiC and 6H-SiC wafers due to the low energy He ion implantations. The AFM results show that the He implantation manifests swelling of the surface of the samples. It is also observed that the surface roughness of the 4H-SiC is approximately three times higher than the 6H-SiC after He implantation. The Raman spectra show enhancement in the second order optical modes which are stronger in the 4H –SiC and are complimentary to the observed surface roughness. This optical enhancement is also associated with the sp^2/sp^3 hybridization of the carbon. The Raman spectra also indicate the presence of monoatomic lattice of Si atoms from the enhancement of the acoustic phonons.

Keywords: Ion Implantations, SiC, Raman.

1. Introduction

Silicon Carbide (SiC) is a wide bandgap semiconductor having over 200 polytypes [1] with variations in the band-gaps, excellent thermal conductivity and low thermal expansion, chemical stability, radiation hardness making them a suitable candidate for optoelectronic devices. The 4H, 6H-SiC polytypes have drawn particular interest due to their wide band gap at the room temperature and strong covalent bonds.

Ion implantation is a novel method to selectively implant ions and modify the physical properties in a material system depending upon the ion species, energy and fluence [2]. He implantation in SiC is known to form bubbles at elevated temperature and high-dose [3]. Several papers report the study of He implantation modifying mechanical properties, chemical reactivity and electrical properties [4] [5]. The main objective of this investigation is to understand the damage induced to the surface morphology and the optical enhancement produced by the He^+ ion at few tens of keV range. The major difference between the 4H-SiC and 6 H SiC is in the 3D stacking sequence. This sequence would exhibit different structural and optical properties on ion implantation.

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