ANNEALING EFFECTS ON THE OPTICAL PROPERTIES OF SILICON CARBIDE (SIC) THIN FILMS

SITI HAFIZAH ABDUL RAUF

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ABSTRACT

ANNEALING EFFECTS ON THE OPTICAL PROPERTIES OF SILICON CARBIDE (SIC) THIN FILMS

Silicon carbide (SiC) thin films were initially deposited at 250 °C and deposition rates of 0.12 cm/s using a home-built HW-CVD system. Much attention has been given to SiC as the most mature of the wide-bandgap semiconductor having a variation of energy-gap between 2.0 eV and 7.0eV. In this experiment, SiC thin film was chosen to be annealed as to improve its electronic properties via heat treatment. The change in the SiC thin film that affects the optical properties of the thin film is studied. In order to study the effects on the properties of the film, the SiC thin film was annealed at elevated temperatures between 100 °C to 400 °C. Studies were done through characterizations using ultraviolet visible spectra, X-ray diffraction spectra and Raman spectroscopy. It was found that annealing has affected the properties of the film. The optical band gap of the films was increased from 1.77 eV to 2.71 eV. The refractive index was also increased from 2.14 to 2.25 and the film thickness was reduced from 133.56 nm to 119.38 nm. Raman spectroscopy showed the variation in the intensity of the film and showed that the films were amorphous even after it was annealed but there is a variation in the intensity of the film composition. Analysis on the X-ray diffraction spectra of the thin film confirms that the thin film is amorphous silicon carbide (α-SiC).

CHAPTER 1
INTRODUCTION

1.1 Background of study

Silicon (Si) is the material dominating the electronics industry today. However silicon carbide (SiC) has superior properties for power devices compared to silicon. A change of technology from silicon to silicon carbide has revolutionized the power electronics. For instance it will be economically feasible to use power electronics to a much larger extent than today. SiC are widely used in semiconductor device where Casady and Johnson (1996), state that SiC is a material long known with potential for high temperature, high power, high frequency and radiation hardened applications which has emerged as the most mature of the wide bandgap semiconductors (2.0 eV $\leq E_g \leq$7.0 eV) since the release of commercial 6H-SiC bulk substrates in 1991 and 4H-SiC substrates in 1994.

SiC also has several advantages where it has commercial availability of substrates, the device processing techniques is known, has a high thermal conductivity and high electric field breakdown strength. In previous research, the annealing effect on SiC was examined in structurally where SiC with a toughened microstructure is an important structural ceramic because of its excellent properties including high temperature strength, chemical stability and resistance to wear and oxidation (Laine et al., 1998). Usually, annealing of SiC thin film result in drastic changes in the electrical, mechanical and chemical properties.