Chapter 1
Introduction

Amorphous silicon is one of the most extensively investigated materials since the early 1970s in physics, material sciences and engineering. Hydrogenated amorphous silicon (a-Si:H) which has a certain percentage of hydrogen passivating the dangling bond in amorphous silicon was found to have improved electronic properties. It has many vast applications such as solar cell [1,2], photoreceptors flat panel display, TFT transistor, printer heads and image sensing devices [3]. This material has the advantage of lower cost production and can be fabricated on large curved and flexible substrates as compared to crystalline silicon [1,3].

The properties of hydrogenated amorphous silicon (a-Si:H) are greatly affected by the preparation conditions and techniques [4]. The optimization of the preparation parameters during the plasma glow discharge deposition results in a-Si:H films that fulfill the required properties for various application being produced. However, these preparation conditions unfortunately are associated with very low deposition rates that make some applications impractical. Higher power density, silane flow-rates and pressure also known to enhance the deposition rates, however result in the powder formation and deterioration of the a-Si:H film properties [5]. In the studies on the effects of inert gasses dilution on deposited a-Si:H film[6], some gasses are found to enhance the deposition rates and also improve the structural properties of a-Si:H film. Argon dilution of silane in plasma enhanced chemical vapour deposition of a-Si:H films is a great interest to researchers in this field of research. Due to its non-chemical reactivity and metastable state [7], argon dilution is widely utilized to enhance deposition rates and improve the a-Si:H properties. However, a-Si:H from argon diluted silane plasma glow discharge are still being studied

widely as the action of argon ion bombardment have both beneficial and detrimental effects on the materials properties [8].

In this work, the effects of argon dilution on the properties of a-Si:H film were studied. The argon diluted a-Si:H films were produced by the horizontal d.c plasma glow discharge decomposition technique at room temperature on crystal silicon and glass substrates. The argon and silane gasses at different flow-rates are mixed and discharged in the deposition chamber to produce the a-Si:H films. The optical and morphological properties of the a-Si:H films were investigated utilizing the UV-VIS-NIR spectrophotometer and Atomic Force Microscope (AFM) respectively.

The literature review and relevant theoretical concepts related to the present studies are presented in chapter 2. This includes discussions of the various deposition techniques, optical properties and structural properties of a-Si:H film. A review on works by other researchers on the effects of argon dilution of silane on a-Si:H films are also presented.

Chapter 3 focuses on the experimental techniques carried out in this work. The setup of the d.c plasma glow discharge system and the deposition process of the a-Si:H films produced from argon diluted silane plasma discharge are presented. The characterization experiment of the films using the UV-VIS-NIR spectrophotometer and Atomic Force Microscope are detailed in this chapter.

The results of the optical characterization of the a-Si:H samples studied are presented in chapter 4. The optical transmission spectra of the a-Si:H films studied in this work are presented and discussed. This followed by the calculation techniques and used in determining the film thickness, refractive index and optical energy gap and Urbach Tail bandwidth. The effects of argon dilution of silane on the deposition rates and optical properties of a-Si:H films are discussed and analyzed in this chapter.

The surface morphological studies of the a-Si:H films using the AFM is presented in chapter 5. The AFM images of samples presented using different argon to silane flow-rate ratios and different substrates are studied and analyzed. The effects of argon dilution of silane on the surface roughness and grain size of a-Si:H films are also investigated in this chapter.

Chapter 6 concludes the studies and results produced in this work. The effects of argon dilution of silane on the optical properties and morphological properties of the a-Si:H films are presented. The influence of substrates on the film morphology is also presented. This chapter ends with some suggestions for the further work in this area of research.

References

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