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THIPWAN SUJARIDCHAI : A STUDY ON BASIC PROPERTIES OF AMORPHOUS SILICON ALLOYS AND THEIR APPLICATIONS TO OPTOELECTRONICS. THESIS ADVISOR : ASSO. PROF. DUSIT KRUANGAM, D.Eng. 119 pp. ISBN 974-636-610-6

Hydrogenated amorphous silicon alloys, i.e., amorphous silicon (a-Si:H), amorphous silicon carbide (a-SiC:H) and amorphous silicon nitride (a-SiN:H) were deposited by the glow discharge plasma CVD method. Their basic optical and electronic properties were studied. The basic optical constants including optical absorption coefficient, reflectivity, refractive index, extinction coefficient, dielectric constants, were investigated by using the Kramers-Kronig relations. The results showed that the optical constant parameters could widely be changed by varying the deposition conditions. For example, by increasing the ratio of C_2H_4/SiH_4 gas sources, the refractive index wil be decreased. Moreover, it has been found that the photon energy of the peaks of dielectric constant spectra monotonically increased as the optical energy gaps of the films increased. The information form the dielectric constant spectra implied that the atomic networks in the films conserved the short range order as seen in crystalline silicon.

The study of electronic properties have been done by using the CPM (Constant Photocurrent Method) technique. The CPM technique gave the spectra of the optical absorption coefficient in the low absorption regions of 0.8-1.3 eV , where reflected the information of the localized states in the band gap of a-Si:H. The results showed that the a-Si:H deposited at the substrate temperature of 200 ^{o}C would have the density of the defect states lower than those deposited at 300 ^{o}C.

The important information obtained above were used in the designs and conditions for the fabrication of three kinds of the amorphous optoelectronic devices, i.e., thin film light emitting diodes (TFLEDs), thin film photodiodes (TFPDs) and thin film optoelectronic integrated circuits (OEICs). The improvement of the brightness of the a-SiC:H p-i-n junction TFLEDs were done through the optimization of the thickness of the p-layer. The fabrication of matrix TFLEDs having the pixel size as small as 0.2 mm by 0.2 mm and with good uniform thickness were succeeded for the first time.

The OEICs consisting of only amorphous materials have been developed for the first time. The simplest elements in the amorphous OEICs were the combination of a-SiC:H TFLEDs, a-Si:H TFPDs and glass waveguides. The amorphous OEICs had the monolithic structures where all of the elements were constructed on a single glass substrate. The proposed OEICs are useful as an optical coupler, optical isolator, data transmission, etc. By adding thin film transistors to these devices, various kinds of logic circuits might be realized.

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