Investigation of the Si doping effect on the Ga_2O_3 films prepared by atomic layer deposition

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Precise control dopant composition and systematic study the doping effect are critical to the production of functional films with desired properties. In this study, we make the original try to use atomic layer deposition (ALD) to fabricate Si-doped Ga_2O_3 films. Optical spectrometry, Hall measurements, X-ray photoelectron spectroscopy and several other measuring techniques were applied to characterize and analyze the optical, electrical and structural properties of the doped films. The experiment results indicated that the content of the Si has an obvious influence on the photoelectrical properties of Ga_2O_3 films. The refractive index of Ga_2O_3 films was decreased with the increasing of the Si content. The Ga_2O_3 energy gap can be tuned from 4.75 to 4.92 eV through Si doping. The average transmittance was larger than 95% from ultraviolet to visual wavelength for all these Si-doped Ga_2O_3 films although the optical transparency was reduced after the Si doping. These results suggesting that the Ga_2O_3 film-based devices such as transparent electrodes, photodetectors or thin film transistors can be further optimized the structural quality and conductivity by improving ALD process.

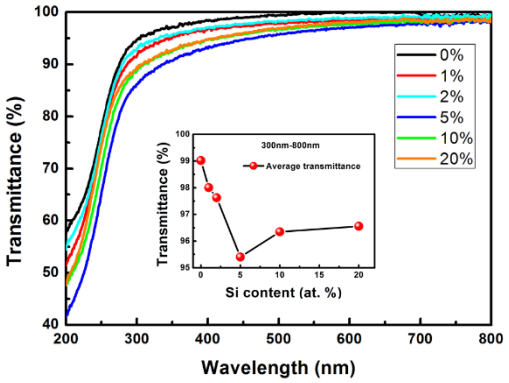

Fig. 1. Transmittance spectra for Ga_2O_3 films varied with Si content. The insert shows the average transmittance in the wavelength of 300-800 nm as a function of Si content.

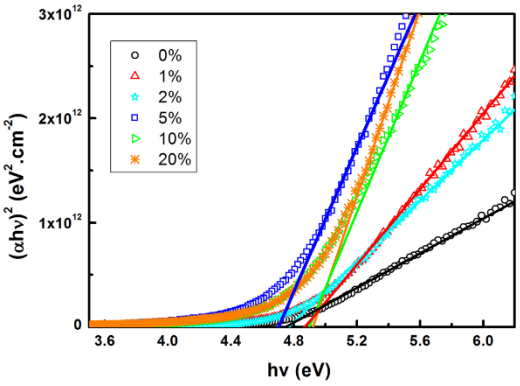

Fig. 2. The $(\alpha h\nu)^2$-$h\nu$ relation for Ga_2O_3 films with increasing Si content.