Low Temperature Growth of Al-doped and Undoped ZnO Films by Pulsed Laser Deposition

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Al doped and undoped ZnO films as transparent conducting oxide coating were deposited by using pulsed Nd:YAG laser. The films were grown at room temperature to 300°C in O₂ background pressure of 2 to 140 mTorr. The low growth temperature is required to enable devices on polymer substrate. The properties of the samples were measured by using atomic force microscopy (AFM), UV-visible spectroscopy, 4 point probe method and Hall Effect measurement. Nanostructure films (Fig. 1) were produced and transmission of the films in the visible region of more than 80% was obtained. The resistivity of undoped ZnO sample was more sensitive to substrate temperature than the background pressure; deposition at substrate temperature at 300°C as compared to room temperature decreased the films’ resistivity by >4 orders of magnitude. However, the growth of Al doped ZnO sample was more sensitive to background pressure than substrate temperature that low resistivity is obtained at 2.4 mTorr, with substrate temperature in wide range of 100 to 200°C. The roles of dopant, substrate temperature and O₂ pressure in the growth of the films were discussed.

Fig. 1 AFM image of Al-doped ZnO film deposited at 100°C