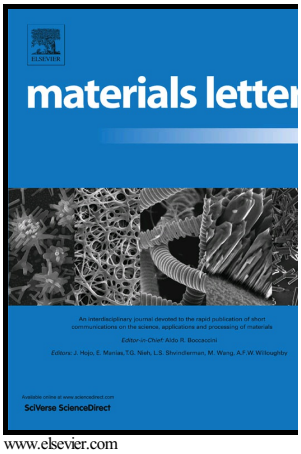

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Mechanistic Study on Highly Crystalline (002) Plane Bounded ZnO Nanofilms Prepared via Direct Current Magnetron Sputtering

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Abstract

ZnO nanofilm has been irreplaceable especially in nanoscale researches due to the unique tunability of its morphology and semiconductor properties, suiting the needs of different applications. In present work, we employed direct current (DC) magnetron sputtering technique to deposit ZnO films, aiming to elucidate the relationship between sputtering pressure and the morphology, crystallinity and defect states of the films. The sputtering pressure was deliberately varied at low pressure regime and highly crystalline (002) plane bounded ZnO nanofilms were successfully prepared at the pressure condition of 15.0 mTorr. With increasing sputtering pressure, photoluminescence analysis indicates that more intrinsic defects were created in ZnO lattice structure. In contrast, Hall Effect measurement shows that the sheet resistivity of ZnO film reduced, corresponding to the increasing number of free charge carriers inside the films. The thermodynamic and kinetic transitions among the reactants and the texture of sputtering surface are the major factors affecting the formation of high quality ZnO nanofilms. The highly crystalline nanograined ZnO films reported in this study is a very promising structure with interesting material properties for future optoelectronic and spintronic applications.

Keywords: Nanofilm; Sputtering; Nanocrystalline materials; Atomic force microscopy; Grain boundaries; Phase transformation