

ALUMINUM DOPED ZINC OXIDE DEPOSITED BY ATOMIC LAYER DEPOSITION AND ITS APPLICATIONS TO MICRO/NANO DEVICES

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Abstract

This work reports investigation on the deposition and evaluation of an aluminum-doped zinc oxide (AZO) thin film and its novel applications to micro- and nano-devices. The AZO thin film is deposited successfully by atomic layer deposition (ALD). 50 nm-thick AZO film with high uniformity is checked by scanning electron microscopy (SEM). The element composition of the deposited film with various aluminum dopant concentration is analyzed by energy-dispersive X-ray spectroscopy (EDX). In addition, a polycrystalline feature of the deposited film is confirmed by selected area electron diffraction (SAED) and high-resolution transmission electron microscopy (HR-TEM). The lowest sheet resistance of the deposited AZO film is found at 0.7 k Ω / \square with the aluminum dopant concentration at 5 at%. A novel method employed the ALD in combination with the sacrificial silicon structures is proposed which opens the way to create the ultra-high aspect ratio AZO structures. Moreover, based on this finding, three kinds of micro- and nano-devices employing the deposited AZO thin film have been proposed and demonstrated. Firstly, nanowalled micro-hollows with an aspect ratio of 300 and a height of 15 μ m are successfully produced. Secondly, micro- and nano-fluidics, including a hollow fluidic channel with a nanowall structure as a resonator and a fluidic capillary window as an optical modulator is proposed and demonstrated. Lastly, nanomechanical resonators consisting of a bridged nanobeam structure and a vertical nanomechanical capacitive resonator are fabricated and evaluated.

Key word: Aluminum doped zinc oxide, atomic layer deposition, micro-hollows, micro-and nano-fluidics, nanomechanical resonators.

Short- Biography

Nguyen Van Toan received the B.S in 2006 and M.S. degree in 2009 in physics and electronics from University of Science, Vietnam National University, Ho Chi Minh City, Viet Nam. He received his Dr. Eng. degree with the research of silicon capable of integration of LSI for application of timing device from Tohoku University in 2014. He is working as an associate professor at Micro System Integration Center, Tohoku University. His current research interest is silicon resonators, optical modulator devices, Metal-assisted chemical etching, and thermoelectric generators.