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A study on controllable aluminium doped zinc oxide patterning by chemical etching for MEMS application (Article)

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Abstract

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This present work reports on the study of controllable aluminium doped zinc oxide (AZO) patterning by chemical etching for MEMS application. The AZO thin film was prepared by RF magnetron sputtering as it is capable of producing uniform thin film at high deposition rates. X-Ray diffraction (XRD) and atomic force microscopy (AFM) characterization were done to characterize AZO thin film. The sputtered AZO thin film shows c-axis (002) orientation, low surface roughness and high crystalline quality. To pattern AZO thin film for MEMS application, wet etching was chosen due to its ease of processing with few controlling parameters. Four etching solutions were used namely: 10 % Nitric acid, 10 % Phosphoric acid, 10 % Acetic acid and Molybdenum etch solutions. For the first time, chemical etching using Molybdenum etch that consist of a mixture of CH_3COOH, HNO_3 and H_3PO_4 was characterized and reported. The effect of these acidic solutions on the undercut etching, vertical and lateral etch rate were studied. The etched AZO were characterized by scanning electron microscopy (SEM) and stylus profilometer. The investigations showed that the Molybdenum etch has the lowest undercut etching of 7.11 µm, and is highly effective in terms of lateral and vertical etching with an etch ratio of 1.30. Successful fine patterning of AZO thin films was demonstrated at device level on a surface acoustic wave resonator fabricated in 0.35 µm CMOS technology. The AZO thin film acts as the piezoelectric thin film for acoustic wave generation. Patterning of the AZO thin film is necessary for access to measurement probe pads. The working acoustic resonator showed resonance peak at 1.044 GHz at 45.28 dB insertion loss indicating that the proposed Molybdenum etch method does not adversely affect the device's operating characteristics. © 2016, Springer-Verlag Berlin Heidelberg.

Indexed keywords

Engineering controlled terms: Acoustic surface wave devices, Acoustic waves, Aluminum, Atomic force microscopy, CMOS integrated circuits, Deposition, Deposition rates, Magnetron sputtering, Molybdenum, Nitric acid, Scanning electron microscopy, Surface roughness, Wet etching, X-ray diffraction, Zinc, Zinc oxide, Acoustic wave generations, Controlling parameters, High-crystalline quality, Low surface roughness, Operating characteristics, Piezoelectric thin films, rf-Magnetron sputtering, Surface acoustic wave resonators

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