

# JMEMS Letters

## 1 Controlled Chemical Etching of ZnO Film for Step 2 Coverage in MEMS Acoustic Sensor

3 Mahanth Prasad, R. P. Yadav, V. Sahula, V. K. Khanna, and  
4 Chandra Shekhar

5 **Abstract**—In this letter, we report a novel wet etching technique of a  
6 *c*-axis-oriented ZnO film that solves the step coverage problem during for-  
7 mation of electrodes on this film. The negative profile or hanging structure  
8 of ZnO film deposited by RF magnetron sputtering was obtained during  
9 wet etching in HCl and NH<sub>4</sub>Cl solutions. The developed technique uses  
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16 from 1.3 to 3.4 μm to observe the coverage of sidewall of ZnO film.  
17 The structure was also electrically tested and was found to function  
18 satisfactorily. [2011-0298]

19 **Index Terms**—Electrolytic copper addition, piezoelectric ZnO film,  
20 positive slope, step coverage.

### 21 I. INTRODUCTION

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25 [2], and acoustic sensors [3], [4]. Various deposition techniques, such  
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27 sputtering [6], and metal–organic chemical-vapor deposition, have  
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technique to overcome the problem of Al step coverage on patterned 45  
ZnO film (of 1.0–3.4-μm thickness) used in the fabrication of MEMS 46  
acoustic sensors. 47

### II. EXPERIMENT

#### A. Fabrication of Test Structure

The cross-sectional view of the structure is shown in Fig. 1(a). The 50  
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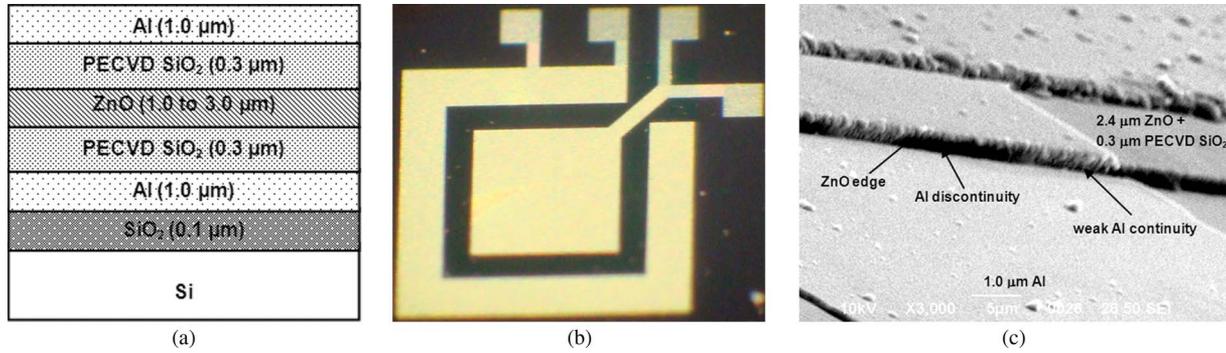


Fig. 1. (a) Cross-sectional view of the structure. (b) Top view of the fabricated structure. (c) SEM image of the ZnO edge etched using 0.25% HCl.

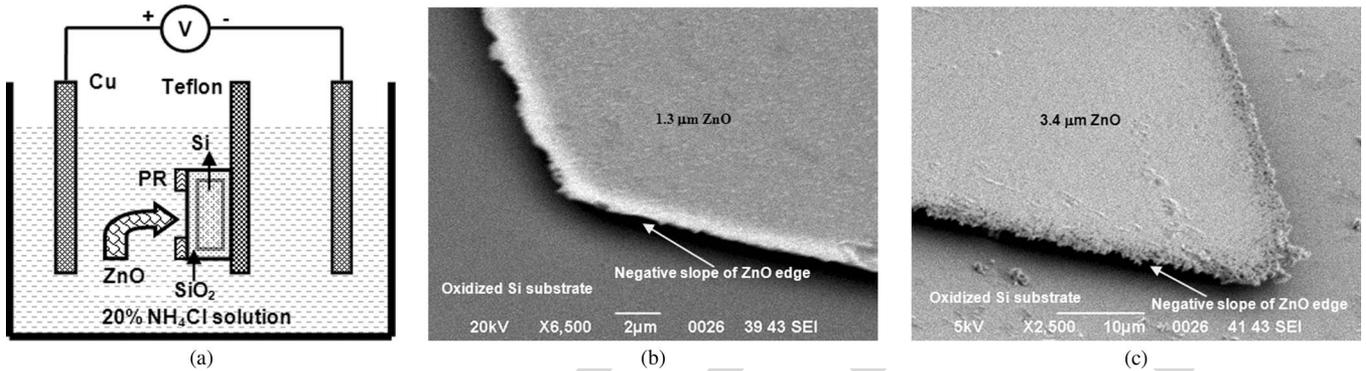


Fig. 2. (a) ZnO vertical etching setup. (b) SEM image of 1.3- $\mu\text{m}$ -thick ZnO edge using vertical etching setup with 20%  $\text{NH}_4\text{Cl}$  solution. (c) SEM image of 3.4- $\mu\text{m}$ -thick ZnO edge using vertical etching setup with 20%  $\text{NH}_4\text{Cl}$  solution.

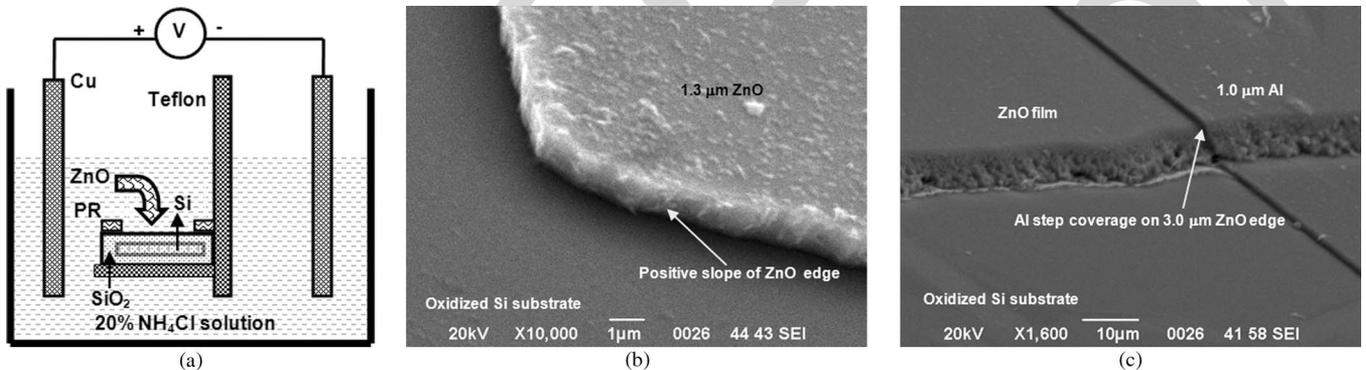


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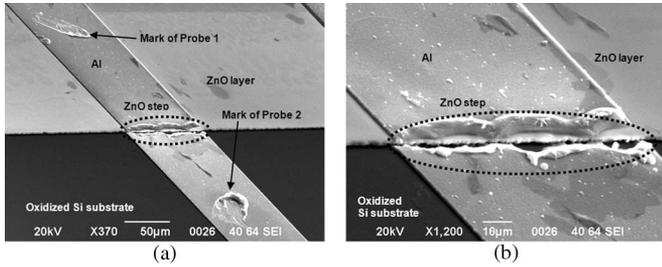


Fig. 4. SEM image of the improved structure after passing high current between probe points 1 and 2. (a) Discontinuity of Al over the ZnO step. (b) Closer view of Al discontinuity at step.

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III. CONCLUSION

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FINAL PROOF

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AQ1 = “CSIR-Central Electronics Engineering Research Institute” was changed to “Central Electronics Engineering Research Institute, Council of Scientific and Industrial Research.” Please check if appropriate.

AQ2 = Please validate the address and postal code provided for “Rajasthan Technical University.”

AQ3 = Please validate the address and postal code provided for “Malaviya National Institute of Technology Jaipur.”

AQ4 = “Experimental” was changed to “Experiment.” Please check if OK.

AQ5 = 4’ was changed to 4 in (as inches). Please check if appropriate.

AQ6 = In this sentence, “power” was deleted since only the values of the three parameters, i.e., gas composition, pressure, and deposition rate, were given. Please check if appropriate.

AQ7 = “SEM” was defined as “scanning electron microscope.” Please check if correct.

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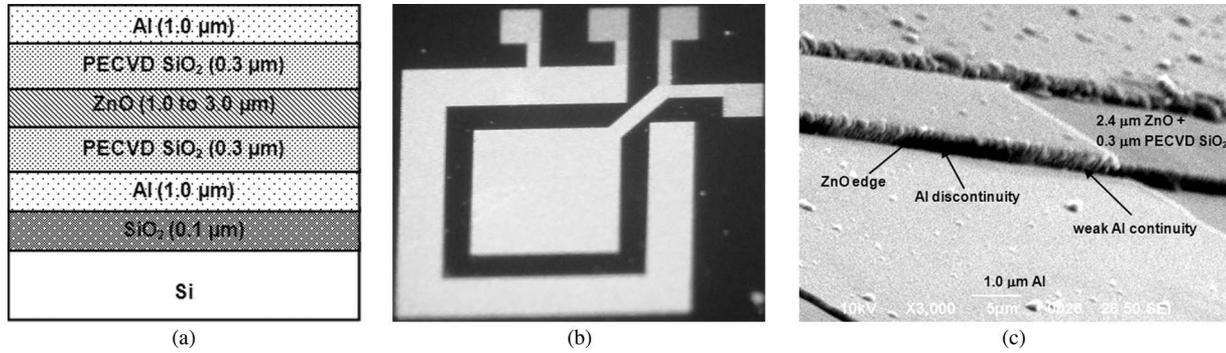


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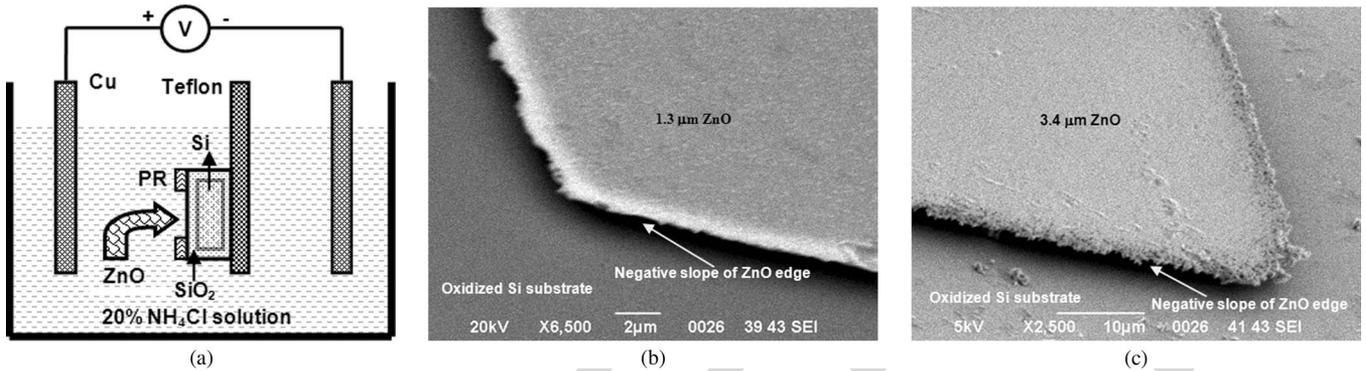


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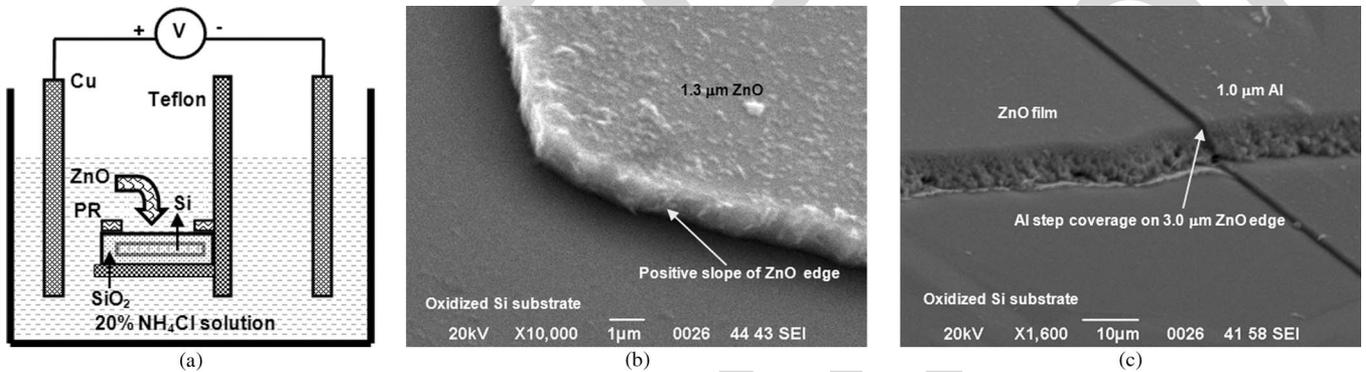


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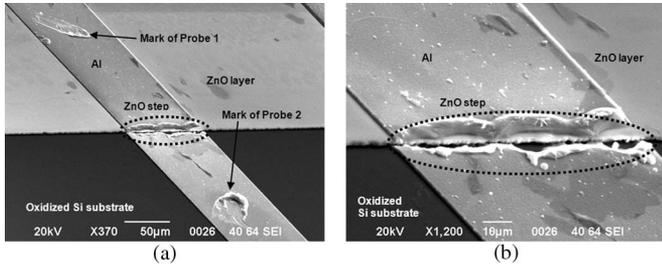


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## AUTHOR QUERIES

AUTHOR PLEASE ANSWER ALL QUERIES

AQ1 = “CSIR-Central Electronics Engineering Research Institute” was changed to “Central Electronics Engineering Research Institute, Council of Scientific and Industrial Research.” Please check if appropriate.

AQ2 = Please validate the address and postal code provided for “Rajasthan Technical University.”

AQ3 = Please validate the address and postal code provided for “Malaviya National Institute of Technology Jaipur.”

AQ4 = “Experimental” was changed to “Experiment.” Please check if OK.

AQ5 = 4’ was changed to 4 in (as inches). Please check if appropriate.

AQ6 = In this sentence, “power” was deleted since only the values of the three parameters, i.e., gas composition, pressure, and deposition rate, were given. Please check if appropriate.

AQ7 = “SEM” was defined as “scanning electron microscope.” Please check if correct.

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