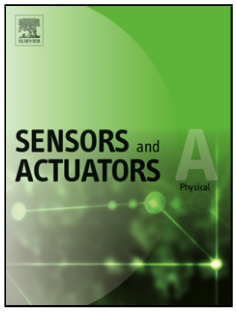

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Ultra-High Efficiency Piezotronic Sensing Using Piezo-Engineered FETs

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Abstract:

A large piezoelectric effect in the c-axis of Zinc Oxide (ZnO) nanorods (NRs) which are vertically aligned to the gate of an nMOSFET is demonstrated. A controlled mechanical pressure was applied to create piezoelectric polarization in the structure and induce charges in the transistor's channel. The resultant piezo-induced charges could modulate the electrostatics of the transistor channel and sense the pressure. ZnO NRs were grown using hydrothermal and microwave-assisted methods and the piezoelectric quality of each one was evaluated. The NRs grown by sequential microwave–assisted growth demonstrated the optimum response. An induced piezo-potential as large as 3.5 V was measured on the transistor's gate when a vertical force of 1.5 N (10 MPa) was applied to the array of NRs and the corresponding piezoelectric coefficient of 66 pC/N was calculated. Such a large enhancement in the piezoelectricity (five-fold increase compared to ZnO thin films) attributes to the high crystal quality of the ZnO NRs, high mechanical flexibility, as well as low potential loss at the electrical contacts of the NRs to the device.

KEYWORDS: Piezotronics, MOSFET, ZnO nanorods, Piezoelectric, Dipole, Force sensing