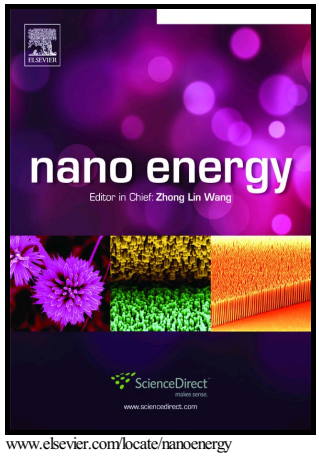

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Electric Potential and Carrier Distribution in a Piezoelectric Semiconductor Nanowire in Time-harmonic Bending Vibration

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Abstract

We study a ZnO piezoelectric semiconductor nanowire in bending vibration with shear deformation for energy harvesting application. The wire is a cantilever fixed at one end and is driven by a time-harmonic transverse shear force at the other end. A theoretical analysis is performed using one-dimensional equations based on the phenomenological theory of piezoelectric semiconductors consisting of the momentum equation, the charge equation of electrostatics, and the conservation of charge for holes and electrons. An analytical solution is obtained. The distributions of the electric potential and carrier concentration near resonances are calculated. The fields at the first resonance are qualitatively similar to the static fields. At the second and higher resonances the fields reverse their directions when crossing the nodal points of the vibration modes. The results obtained are fundamental to the development and optimization of energy harvesters and other devices based on the bending vibration of ZnO nanowires.

Keywords: piezoelectric semiconductor nanowire; bending vibration; energy harvesting

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