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Electroelastic Fields for Piezoelectric Threading Dislocation in Various Growth Orientations of Gallium Nitride [†]

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Abstract

Linear piezoelectric formulations were employed to analytically evaluate the electroelastic field generated by a single threading edge/screw dislocation in piezoelectric gallium nitride (GaN) thin film. All possible growth orientations, namely *c*-plane (polar), *a*- and *m*-planes (non-polar), and (11 $\bar{2}$ 2)-plane (semi-polar) of GaN layers were considered for the analysis. Single piezoelectric threading edge and screw dislocations were also modeled by a commercial finite element analysis code, ABAQUS 6.14. The edge dislocation was modeled by invoking one-dimensional thermal strain analogy to effectively introduce an extra plane of atoms. The screw dislocation was modeled by creating a slip in opposite surfaces by applying opposite displacements of magnitude equal to half the Burgers vector parallel to the direction of dislocation line. We also evaluated the Peach-Koehler force acting on a piezoelectric dislocation as well as the material force calculated by the *J*-integral. The effects

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[†]This paper is dedicated to the late Prof. Seung-Hyun Yoo.

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