CC PUB #276

April 1999

Electrical Isolation of GaN by Ion Implantation Damage: *Experiment and Model*

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Abstract

Electrical and optical isolation of unintentionally doped GaN layers due to the damage created by H^+ and He^+ ions passing through the layer are demonstrated. As a result of the irradiation, the sample resistance increases by 11 orders of magnitude and the band-to-band photoluminescence (PL) emission is totally quenched. Following annealing (1000^oC, 30sec), the conductivity can be nearly completely recovered whereas only partial recovery of the PL emission is obtained. A model is proposed which invokes the presence of potential barriers for electronic transport across extended defects as the major factor limiting carrier mobility. Radiation defects increase these barriers, thus affecting the sample resistivity. This model fits the experimental results for both H and He induced damage extremely well and thus proves that defects created by nuclear collisions of the ions traversing the layer are responsible for the observed effects.