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Influence of Crystalline Defects in GaN-InGaN Solar Cells BALAKRISHNAM JAMPANA, NIKOLAI FALEEV, University of Delaware, IAN FERGUSON, Georgia Tech, ROBERT OPILA, University of Delaware, CHRISTIANA HONSBERG, Arizona State University — Crystalline defects originating from lattice-mismatch in epitaxial materials appear to be the dominant factor reducing high efficiency solar cell performance. In this paper we present an explanation of the observed structural and optical characteristics originating in lattice-mismatched III-nitride epitaxial materials. This model is based on creation, diffusion, accumulation and structural transformation of point defects to extended crystalline defects. In this work InGaN photovoltaic structures are grown by MOCVD on GaN templates with thicknesses in the 50 to 400nm range. The types and spatial distribution of crystalline defects are determined from XRD rocking curves and reciprocal space maps. The crystalline quality is observed to deteriorate with increasing thickness and growth rate. Wide band gap InGaN based solar cells require 150 to 400nm of active layer thicknesses and crystalline defects are observed in this thickness range degrading the solar cell performance. A physical model correlating the response of the solar cell to the type and spatial distribution of the defects will be presented. The work will aid improve the crystalline quality of InGaN for application as high efficiency solar cells.

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