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Time-Resolved Electroabsorption Measurement of Electron Velocity in InGaN Heterostructures due to Internal Electric Fields BLAIR CONNELLY, CHAD GALLINAT, NATHANIEL WOODWARD, RYAN ENCK, GRACE METCALFE, RANDY TOMPKINS, SHUAI ZHOU, KENNETH JONES, HONGEN SHEN, MICHAEL WRABACK, US Army Research Laboratory — Carrier transport was measured in c-plane, p-down, n-GaN/i-$In_{1-x}Ga_xN$/p-GaN solar cell heterostructures using a time-resolved electroabsorption pump-probe technique with sub-picosecond resolution. Large built-in electric fields are present in the InGaN region associated with the termination of large polarization at hetero-interfaces. The change in transmission of a probe beam (tuned for maximum sensitivity to changes in the band edge) due to the transport of photogenerated carriers under the built-in field is monitored to determine the electron transit time and average electron velocity. Time-domain THz measurements indicate the direction of electron transport is dominated by drift towards the n-GaN. Samples with a 200-nm $In_{0.13}Ga_{0.87}N$ layer show a change in signal rise time with carrier density. At the lowest injection level, an $\sim$ 1.5-ps rise time is observed, which corresponds to an average electron velocity of 6.7x10^6 cm/s for an average distance of travel of 100 nm in an internal field of $\sim$ 135 kV/cm. This velocity is significantly smaller than in GaN with a similar field, which may be indicative of transport through compositional inhomogeneities.

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