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Electrical properties of point and extended defects in indium nitride[1]

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The surface and bulk electrical properties of indium nitride (InN) are determined by point and extended native defects to an extent greater than in any other III-V semiconductor. The n-type behavior of undoped InN thin films and the surface accumulation layer of electrons reflecting surface Fermi level pinning high in the conduction band are now well-established experimentally and understood in terms of InN's large electron affinity, nearly 6 eV. However, the properties of Mg-doped material (is it really p-type?) and the effect on electron concentration and transport of the high density of extended defects was, until recently, less well understood. A coordinated experimental approach using a combination of electrical and electrothermal measurements will be described that allows definitive evaluation of hole transport in Mg-doped InN and, when combined with transport modeling based on solutions to the Boltzmann transport equation, a quantitative understanding of the crucial role of charged line defects in limiting electron transport in this material. The use of thermopower is especially noteworthy as it mitigates the effect of the ubiquitous surface accumulation layer which had prevented direct measurement of hole transport by Hall effect. The extension of the present transport measurement methodology to other systems including buried interfaces and heterojunctions will also be described.

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