GOLDMAN, RACHEL  
(University of Michigan)  

Effective Masses in Dilute Nitride Bismide Semiconductor Alloys: Failure of the Band Anti-Crossing Model?  
Tassilo Dannecker\textsuperscript{1,2,3}, Yu Jin\textsuperscript{2,3}, Hailing Cheng\textsuperscript{3}, Charlie F. Gorman\textsuperscript{2}, John Buckeridge\textsuperscript{1}, Ctirad Uher\textsuperscript{3}, Stephen Fahy\textsuperscript{1,3}, Cagliyan Kurdak\textsuperscript{3}, Rachel S. Goldman\textsuperscript{2,3}  
\textsuperscript{1}Tyndall National Institute, University College Cork, Cork, Ireland  
\textsuperscript{2}Department of Materials Science and Engineering, University of Michigan, Ann Arbor, Michigan 48109-2136, USA  
\textsuperscript{3}Physics Department, University of Michigan, Ann Arbor, Michigan 48109-1040, USA  

Abstract: The semi-empirical band anti-crossing (BAC) model proposed by Shan et al has successfully explained the bandgap bowing effect in both dilute nitride and dilute bismide semiconductor alloys. Within this model, a higher (lower) lying localized N (Bi) band interacts with the extended host semiconductor band resulting in a split of the CB (VB) into two sub-bands. Although the BAC model qualitatively predicts the N composition dependence of the GaAsN bandgap, it does not quantitatively explain several extraordinary optical and electronic properties of GaAsN and related alloys. We have investigated the N-composition, x, and T-dependence of the electron effective mass, $m^*$, of GaAs\textsubscript{1-x}N\textsubscript{x}. Using Seebeck and Hall measurements, in conjunction with assumptions of parabolic bands and Fermi-Dirac statistics, we find a non-monotonic dependence of $m^*$ on x and an increasing $m^*$ T-dependence with x. These trends are not predicted by the two-state BAC model but instead are consistent with the predictions of the linear-combination of resonant nitrogen states model, which takes into account several N-related states and their interaction with the GaAs conduction-band edge. Similar effects for the hole effective mass will be discussed in the GaAsBi system.