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Infrared probe of $Ga_{1-x}Mn_xAs$ films with controlled disorder and compensation BRIAN CHAPLER, University of California San Diego, R.C. MYERS, Ohio State University, S. MACK, D.D. AWSCHALOM, University of California Santa Barbara, M.C. MARTIN, Lawrence Berkeley National Laboratory, A. DATTELBAUM, Los Alamos National Laboratory, K.S. BURCH, University of Toronto, D.N. BASOV, University of California San Diego — Arsenic antisite defects (As_{Ga}) formed due to low temperature growth conditions are a leading cause of disorder and compensation in $Ga_{1-x}Mn_xAs$. Samples grown with gradient As:Ga growth condition for $0.005<x< 0.16$ have allowed for optimized As flux minimizing As_{Ga}. By studying samples at this optimized location via infrared spectroscopy, a new level of precision can be attained in exploring the electronic structure and other intrinsic properties of $Ga_{1-x}Mn_xAs$ samples. Using optical sum rule analysis of our experimentally determined optical conductivity ($\sigma_1(\omega)$), we extract the free carrier band mass (m*) and find it to be several m_e. We also comment on the levels of interstitial Mn (Mn_i), finding for $x > 0.03$ roughly 25% of Mn resides at an interstitial location. Additionally, by probing positions along the As:Ga gradient we directly measure the effects of disorder and compensation on these samples. Systematic changes in $\sigma_1(\omega)$ as As_{Ga} content is increased are reported, and the consequences of this on our understanding of the electronic structure of $Ga_{1-x}Mn_xAs$ are discussed.

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