Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

A dilute ferromagnetic semiconductor with an isolated impurity band: (Ga,Mn)P M.A. SCARPULLA, B.J. CARDOZO, O.D. DUBON, Dept. of Materials Science & Engineering UC Berkeley and Lawrence Berkeley National Laboratory, Berkeley CA 94720, W.M. HLAING OO , M.D. MCCLUSKEY, Dept. of Physics, Washington State University, Pullman, WA 99164 — $Ga_{1-x}Mn_xP$ can provide insight into the physics of ferromagnetic III-V semiconductors because it is expected to be chemically intermediate between $Ga_{1-x}Mn_xAs$, in which free holes in the valence band mediate the ferromagnetic exchange, and $Ga_{1-x}Mn_xN$, where double exchange in an impurity band may provide the ferromagnetic coupling. We have recently synthesized ferromagnetic films of $Ga_{1-x}Mn_xP$ with T_C up to 65 K using Mn ion implantation followed by pulsed-laser melting. We present the first reported electrical transport measurements in $Ga_{1-x}Mn_xP$, which show hopping conduction from 10-300 K with a change in activation energy at T_C, large negative magnetoresistance, and a large anomalous Hall effect reflecting the sample magnetization. The activation energy from resistivity measurements is 29 meV, while far infrared photoconductivity spectra reveal a gap of 26 meV between localized and conducting states. Mid-infrared absorption spectra have identified an impurity band centered near the 0.4 eV binding energy of the Mn acceptor. We interpret these measurements as demonstrating that the Mn band exists and that the ferromagnetic exchange is mediated by carriers in this band.

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Date submitted: 21 Mar 2013 Electronic form version 1.4