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7.2. Magnetic and semimagnetic semiconductors

Polaron Percolation in Mn_xGe_{1-x} Dilute Magnetic Semiconductor

A. P. Li, J. F. Wendelken, and J. Shen
Condensed Matter Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831

L. C. Feldman
Department of Physics and Astronomy, Vanderbilt University, Nashville, TN 37235

H. H. Weitering
Condensed Matter Sciences Division, Oak Ridge National Laboratory, Oak Ridge, TN 37831
and Department of Physics and Astronomy, University of Tennessee, Knoxville, TN 37996

In dilute magnetic semiconductors (DMS), ferromagnetic ordering is carrier mediated. This picture seems to be accepted more or less universally, but the detailed nature of the ferromagnetism varies greatly from system to system. We have studied ferromagnetism and the correlation between transport and ferromagnetism in Mn_xGe_{1-x} DMS for Mn concentrations up to 9%. By carefully controlling the growth conditions, we obtained precipitate-free Mn_xGe_{1-x} that exhibits magnetic phase transitions at T_c = 20 K and T_c^* = 112 K. The magnetic response to temperature and doping concentration is indicative of a magnetic-polaron percolation transition at T_c [1], which coincides with a metal-insulator transition and Hall-effect sign anomaly. T_c^* is the ferromagnetic ordering temperature within isolated polarons which can be determined from a Curie-Weiss plot of the high-temperature magnetic susceptibility. Ferromagnetism in Mn_xGe_{1-x} DMS reveals a striking analogy with the magnetism of so-called “clustered states” in manganite compounds [2].

[1] A. Kaminski and S. Das Sarma, Phys. Rev. B **68**, 235210 (2003)

[2] G. Alvarez and E. Dagotto, Phys. Rev. B **68**, 045202 (2003)

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