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Critical behavior of GaMnAs diluted magnetic semiconductors near the Curie temperature

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GaMnAs have been studied intensely over the last few decades and have become a model system for diluted ferromagnetic semiconductors. At present, it is accepted that the Curie temperature of GaMnAs with metallic type of the conductivity coincides well with the maximum of the temperature derivative of the resistivity dρ/dT, similar to the ferromagnetic metals like Ni and Fe, whereas, for samples with low concentration of free carriers, the T_C coincides with the resistivity maximum. The critical behavior of GaMnAs near the Curie temperature was experimentally studied by using the temperature dependencies of the resistivity, the specific heat, and the magnetization of GaMnAs. It is shown that the determination of T_C from the maximum of the temperature derivative of the resistivity is valid only for the samples with a high concentration of free carriers. For the samples with low concentration of free carriers, the T_C coincides with the resistivity maximum. The magnetic specific heat for $T > T_C$ demonstrates the crossover from the one dimensional to the three dimensional critical behavior when temperature become closer to the Curie temperature. This is explained by the existence of Mn-Mn dimers oriented along one direction at the beginning of the formation of the ferromagnetic phase on the paramagnetic side of the phase transition.

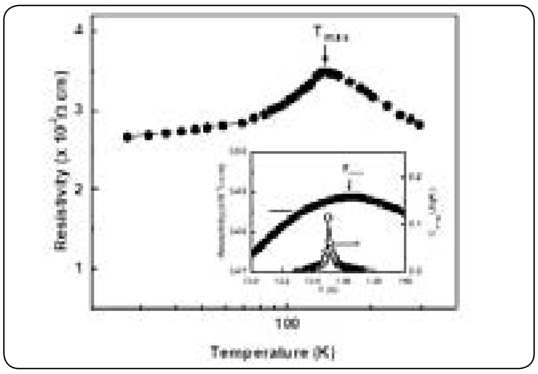

Figure 1: Temperature dependencies of the resistivity for the GaMnAs with 8% of Mn, annealed at low temperature. Inset shows the enlarged picture of the resistivity behavior near the maximum and the magnetic specific heat, respectively.

Recent Publications

1. Z A Yunusov, Sh U Yuldashev, Y H Kwon, D Y Kim, S J Lee, et al. (2018) Band gap engineering of ZnMnO diluted magnetic semiconductor by alloying with ZnS: Journal of Magnetism and Magnetic Materials 446:206–209.
2. Sh U Yuldashev, Z A Yunusov, Y H Kwon, S H Lee, R Ahuja, et al. (2017) Critical behavior of the resistivity of GaMnAs near the Curie temperature: Solid State Communications 263:38-41.
3. Sh U Yuldashev, V Sh Yalishev, Z A Yunusov, Y H Kwon and T W Kang (2016) Magnetic phase transitions in ZnO doped by transition metals: Physica Status Solidi C 13: 559–563.
4. Sh U Yuldashev, V Sh Yalishev, Z A Yunusov, S J Lee, H C Jeon, et al. (2015) Magnetoelectric effect in GaMnAs /P(VDF-TrFE) composite multiferroic nanostructures: Current Applied Physics 15:S22–S25.
5. Sh U Yuldashev, Kh T Igamberdiev, Y H Kwon, S H Lee, X Liu, et al. (2012) Crossover critical behavior of Cd1-xMnxAs: Phys. Rev. B 85: 125202:1–5.

Biography

Shavkat U Yuldashev has completed his PhD in the year 1983 from A.F. Ioffe Institute, Saint-Petersburg. He is the Professor at the Department of Physics of Dongguk University, Seoul, South Korea. He has published more than 175 papers in reputed journals. His expertise is in diluted magnetic semiconductors and spintronics.

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