Exploring Optically Pumped NMR in Dilute Magnetic Semiconductor thin films: $Ga_{1-x}Mn_x$ As

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Gallium-71 optically-pumped NMR (OPNMR) measurements were performed on thin films (0.8 to 8 μm thickness) of the dilute magnetic semiconductor $Ga_{1-x}Mn_xAs$ (where x= 0, 0.01, 0.03), a candidate material for spin-based devices and electronics. The films were grown by low temperature molecular beam epitaxy (LT-MBE) on a bulk GaAs substrate. OPNMR action spectra were collected as a function of photon energy at 3T and 1.5 K using left and right circularly polarized light (see Figure). The OPNMR action spectra, which are compared to theoretical simulations based on the electronic band structure calculations, are strongly affected by low Mn doping levels. Moreover, for x=0.03, the NMR signal intensity was largely insensitive to photon energy and the helicity of incident light, consistent with light induced quadrupolar relaxation rather than by hyperfine mediated electron-nuclear cross-relaxation mechanism.[1, 2] The effects of Mn on the spin polarization dynamics was investigated by varying the laser power and optical irradiation time. In addition, the Mn sites were characterized by X-band EPR spectroscopy at 5 K with and without laser irradiation.

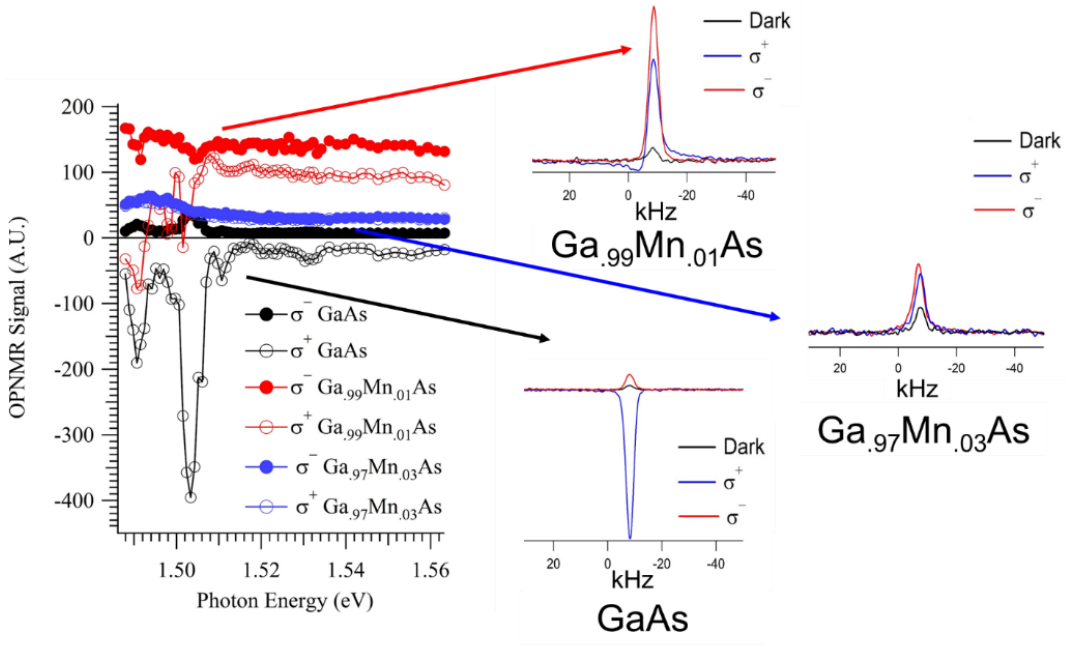

Figure 1. Left is the OPNMR action spectra of the bulk (black), 1% Mn sample (red) and the 3% Mn sample (blue) using left and right circularly polarized light. To the right are representative spectra of each sample at 1.495 eV with left and right circularly polarized light compared to spectra obtained without laser irradiation (dark spectra).

References and Acknowledgements

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