# Study on the structural and magnetic depth profile of $(Ga_{1-x}Mn_xAs/GaAs)_{10}$ multilayers by X-ray Resonant Magnetic Reflectivity

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Multilayer structures of dilute magnetic semiconductor (DMS) have been extensively studied in semiconductor spintronics. In magnetic multilayers, the spin-dependent transport properties, such as the giant magnetoresistance (GMR), is highly dependent on the spin configuration of each magnetic layer. Since the interlayer exchange coupling (IEC) between the individual magnetic layers in such systems results in nontrivial magnetizations, since it is important to understand the magnetic configuration of the multilayer system [1,2].

In this study, the laterally averaged structural and magnetic properties of the $(Ga_{1-x}Mn_xAs/GaAs)_{10}$ multilayer is investigated using X-ray Resonant Magnetic Reflectivity (XRMR). XRMR is very useful tool for such studies because of its sensitivity to surface and interface properties. At zero field, the change in intensity at the two different Half-Bragg peaks indicate that all magnetic layers are antiparallel due to the antiferromagnetic (AFM) IEC [1,3]. With a strong applied magnetic field, the Zeeman energy overcomes the AFM IEC and all magnetic layers are parallel. When the magnetic field is gradually decreased to zero field, it is found that the top-most magnetic layer retains its magnetization direction, while the magnetic layer beneath flips its magnetization. The subsequent layers follow the magnetic configuration of these first two layers resulting in antiparallel spin configuration. Such reversal process is consistently observed in the antiparallel spin configuration regardless of direction of applied magnetic field. We believe these results will help us understand spin-dependent transport in $(Ga_{1-x}Mn_xAs/GaAs)_{10}$ multilayer systems.

## References

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