Magneto-optical Kerr Effect Studies of Magnetic Anisotropy in Tensile-Strained (Ga,Mn)As

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The rich variation of magnetic anisotropy with strain, carrier density, and temperature provides a valuable arena for testing different models of carrier-induced ferromagnetism in III-V ferromagnetic semiconductors. Here, we use the component resolved magneto-optical Kerr effect (MOKE) to investigate the effect of low temperature annealing on the magnetic anisotropy in a set of tensile-strained Ga$_{0.94}$Mn$_{0.06}$As films (thickness ranging from 15 to 120 nm) grown on strain-relaxed (In,Ga)As buffer layers. Deconvolution of the MOKE signal into the longitudinal and polar components shows that, despite the tensile strain, the as-grown samples can have a significant in-plane component of magnetization. Our measurements show that the easy axis of magnetization in as-grown samples reorients towards out-of-plane with increasing temperature, as well as when a second laser is used as a pump. Upon annealing, the in-plane component of magnetization is completely suppressed. We discuss these measurements in the context of the mean-field theory of hole-mediated ferromagnetism in these materials. Supported by DARPA, ONR and NSF.