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Optical Properties of Ferromagnetic Semiconductors

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Ferromagnetic semiconductors hold great promise for numerous magneto-optics applications. In this talk I detail recent optical spectroscopic studies of as grown and annealed thin films and digitally doped superlattices of $Ga_{1-x}Mn_xAs$, prepared in the group of D.D. Awschalom (UCSB) and annealed in the group of N.Samarth (PSU). Annealing induces a large strengthening of the optical conductivity ($\sigma_1(\omega)$), while the frequency dependence of $\sigma_1(\omega)$ remains unchanged. This indicates that the scattering rate and Fermi level have not been effected by annealing, despite the large increase in hole density. Our Infrared work on Digital Ferromagnetic Heterostructures reveals a unique ability to tune their optical properties as well as their intrinsic electronic structure without changing the doping/defect level. This work is in collaboration with D.B. Shrekenhamer, E.J. Singley, D.N. Basov (University of California, San Diego) J. Stephens, R.K. Kawakami, D.D. Awschalom(University of California, Santa Barbara), B.L. Sheu, and N. Samarth (Pennsylvania State University).