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Engineering the interlayer exchange coupling in hybrid ferromagnetic metal/semiconductor heterostructures MARK J. WILSON, MENG ZHU, PETER SCHIFFER, NITIN SAMARTH, Dept. of Physics, Penn State University, University Park PA 16802, ROBERTO C. MYERS, DAVID D. AWSCHALOM, Dept. of Physics, University of California, Santa Barbara CA 93106, MICHAEL E. FLATTE, Dept. of Physics, University of Iowa, Iowa City, IA 52242 — The systematic engineering of exchange coupling in ferromagnetic semiconductor heterostructures is important for developing proof-of-concept spin transfer semiconductor devices. We recently demonstrated interlayer exchange coupling between a ferromagnetic semiconductor ($Ga_{1-x}Mn_xAs$) and a ferromagnetic metal (MnAs) [APL **91**, 192503 (2007)]. Here, we report a comprehensive magnetometry study of the underlying exchange coupling in this hybrid system. We vary key parameters such as the thicknesses of both the ferromagnetic layers and the composition of the $Ga_{1-x}Mn_xAs$ layer, and explain our observations using an "exchange spring" model. We also demonstrate the propagation of the exchange coupling through a non-magnetic spacer layer (p-doped GaAs) and examine the variation of this coupling as a function of the spacer layer thickness and doping. Work supported by the ONR MURI program and by NSF.

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