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Ultrafast Study of Dynamic interfacial Exchange Coupling in Ferromagnet/Oxide/Semiconductor Heterostructures[1] YU-SHENG OU, YI-HSIN CHIU, The Ohio State University, NICHOLAS HARMON, The University of Iowa, PATRICK ODENTHAL, University of California, Riverside, MATTHEW SHEFFIELD, MICHAEL CHILCOTE, ROLAND KAWAKAMI, The Ohio State University, MICHAEL FLATT, The University of Iowa, EZEKIEL JOHNSTON-HALPERIN, The Ohio State University — Time-resolved Kerr/Faraday rotation (TRKR/TRFR) is employed to study GaAs spin dynamics in the regime of strong and dynamic exchange coupling to an adjacent MgO/Fe layer. This study reveals a dramatic, resonant suppression in the inhomogeneous spin lifetime (T2*) in the GaAs layer. Further investigation of the magnetization dynamics of the neighboring Fe layer, also using TRKR/TRFR, reveals not only the expected Kittel-dispersion but also additional lower frequency modes with very short lifetime (65 ps) that are not easily observed with conventional ferromagnetic resonance (FMR) techniques. These results suggest the intriguing possibility of resonant dynamic spin transfer between the GaAs and Fe spin systems. We discuss the potential for this work to establish GaAs spin dynamics as an efficient detector of spin dissipation and transport in the regime of dynamically-driven spin injection in ferromagnet/semiconductor heterostructures.

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