Abstract Submitted for the MAR17 Meeting of The American Physical Society

THz-Driven

Ultrafast Spin-Lattice Scattering in Amorphous Metallic Ferromagnets STEFANO BONETTI, Stockholm University, MATTHIAS HOFFMANN, SLAC National Accelerator Laboratory, MENG-JU SHER, ZHAO CHEN, Stanford University, SEE-HUN YANG, MAHESH SAMANT, IBM Almaden Research Center, STUART PARKIN, Max-Planck Institut fr Mikrostrukturphysik, HERMANN DRR, SLAC National Accelerator Laboratory — We use single-cycle THz fields and the femtosecond magneto-optical Kerr effect to, respectively, excite and probe the magnetization dynamics in two thin-film ferromagnets with different lattice structures: crystalline Fe and amorphous CoFeB. We observe Landau-Lifshitz-torque magnetization dynamics of comparable magnitude in both systems, but only the amorphous sample shows ultrafast demagnetization caused by the spin-lattice depolarization of the THz-induced ultrafast spin current. Quantitative modeling shows that such spin-lattice scattering events occur on similar time scales than the conventional spin conserving electronic scattering (~ 30 fs). This is significantly faster than optical laser-induced demagnetization. THz conductivity measurements point towards the influence of lattice disorder in amorphous CoFeB as the driving force for enhanced spin-lattice scattering.

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Date submitted: 10 Nov 2016

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