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Evidence of Electron Spin-Dependent Terahertz Light Transport in Spintronic-Plasmonic Media KENNETH CHAU, University of Alberta, MARK JOHNSON, Naval Research Laboratory, ABDULHAKEM ELEZZABI, University of Alberta — Plasmonics and spintronics are actively pursued as means to sustain the continued miniaturization of information technology. Combining the advantages of both technologies could potentially pave the way for the development of highly integrated light-based devices. Here, we provide evidence of a new spin-dependent plasmonic phenomenon. Using a rudimentary plasmonic circuit, namely, a dense ensemble of ferromagnetic/nonmagnetic (F/N) metallic microparticles, we demonstrate that electron spin can influence terahertz plasmonic transport across the particles. In particular, by coating the ferromagnetic Co particles with nonmagnetic Au nano-layers, the terahertz transmission shows large magnetic field-dependent attenuation, enhanced relative to that of pure, uncoated Co particles. We show that enhanced magnetic attenuation in the F/N particles arises from dynamic spin accumulation in the nonmagnet. A quantitative measurement of the dependence of the attenuation on the N layer thickness is in good agreement with the spin diffusion length predicted by the spin accumulation model, as well as with other measurements of this length. The discovery may potentially lead to plasmonic devices operating in the visible regime that exploit electron spin.

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