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Understanding the interaction of photonic waveguides with magnetic multilayers for ultra-fast memory devices

F.E. Demirer[1], R. Lavrijsen[1], B. Koopmans[1], J.J.G.M. van der Tol[2]*

[1] Department of Applied Physics, Eindhoven University of Technology, 5600 MB Eindhoven, the Netherlands

[2] Department of Electrical Engineering, Eindhoven University of Technology, 5600 MB Eindhoven, the Netherlands

*f.e.demirer@tue.nl

Increasing rates of data consumption require development of new devices for digital communication and data storage. Devices with integrated magnetophotonics are expected to deliver an answer since photons can facilitate 'writing' [1] and 'reading' of magnetic information stored in metallic multi-layers via spintronic manipulation on ultrafast timescales. This work plays an important role to realize a magnetophotonic device for on-chip all optical reading of magnetic information, i.e. combining racetrack memory with photonics.

Here we will present a design of a tuned multi-layered ferromagnetic, to be used as top layer coating on photonic waveguides. Since light is confined in photonic waveguides and the magnetic information is contained in the magnetic layers on top of this device; the magneto-optic interaction takes place in the form of Magneto-Optic Kerr Effect (MOKE) at the interface. Therefore, maximizing MOKE while minimizing the optical losses are the main objectives of this work. *Figure 1* shows how magneto-optic constant of Co (Q_{Co}) sandwiched between Pt layers reaches a maximum when spin-orbit interaction at the Pt-Co interface is tuned by varying the Co thickness. *Figure 2* compares Kerr rotation enhancement thanks to interface tuning for Ta(1 nm)/Pt(1.5 nm)/Co(0.44 nm)/Pt(0.5 nm)/Co(0.44 nm)/Pt(2 nm) sample (red) with respect to Ta(1 nm)/Pt(2 nm)/Co(0-2nm)/Pt(2 nm) sample (black) at total Co thickness of 0.88 nm.

[1] M. L. M. Lalieu, M. J. G. Peeters, S. R. R. Haenen, R. Lavrijsen, and B. Koopmans, Phys. Rev. B 96, 220411(R) – Published 26 December 2017

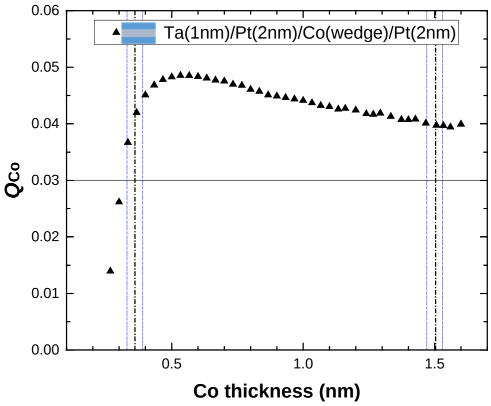

Figure 1. Change in magneto-optic constant of cobalt (Q_{Co}) with respect to its thickness in multilayer stack of Ta(1nm)/Pt(2nm)/Co(0-2nm)/Pt(2nm).

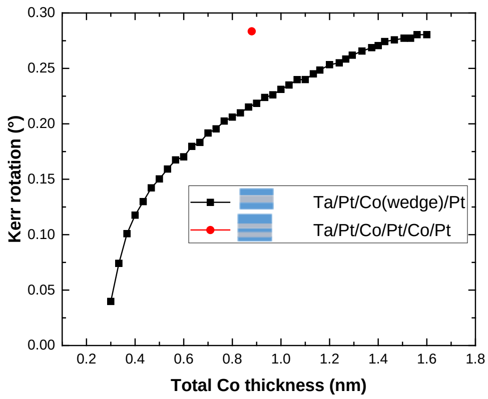

Figure 2. Kerr rotation vs. total cobalt thickness for samples Ta(1nm)/Pt(2nm)/Co(0-2nm)/Pt(2nm)(black) & Ta(1nm)/Pt(1.5nm)/Co(0.44nm)/Pt(0.5nm)/Co(0.44nm)/Pt(2nm) (red).