# Active Mid IR plasmonics using Giant Magneto Resistance

**Gaspar Armelles**, Alfonso Cebollada, Fernando García.

IMM-Instituto de Microelectrónica de Madrid (CNM-CSIC), Isaac Newton 8, PTM, E-28760 Tres Cantos, Madrid, Spain
gaspar@imm.cnm.csic.es

Abstract

Plasmonics has proven as a powerful tool to improve the performance of mid-IR devices, resulting in plasmon assited quantum cascade lasers, plasmon enhanced light detection, plasmonic beam steering, plasmonic thermal emiters or plasmonic nanoantenas for vibrational spectroscopy. In this scenario, the possibility of modulating the emission, propagation and/or detection of mid-IR radiation constitutes a promising aspect to expand the limits of the currently used technologies. In this sense, fast and contactless actuation on plasmon resonances via the Magneto-Optical (MO) effect has been put forward by the inclusion of ferromagnetic components into noble metal layers and nanostructures, yet up to now restricted to the visible and near-infrared ranges.

Here we present our proposal and initial results on the magnetic field control of plasmon resonances in the mid IR region by the use of the Magneto-Refractive (MR) effect, i.e., a change in the optical properties of the system by magnetic field controlled electrical resistivity. For this we select a Giant Magneto Resistance model system (a Au/Permalloy multilayer), which exhibits changes in resisitivity of the order of 10% by the application of small (of the order of 20 Oe) magnetic fields. The experiments are carried out in a dedicated FTIR spectrometer with magnetic field capabilities.

## References

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[3] S.S.P.Parkin et al., Physical Review Letters 72 (1994) 3718.

## Figures

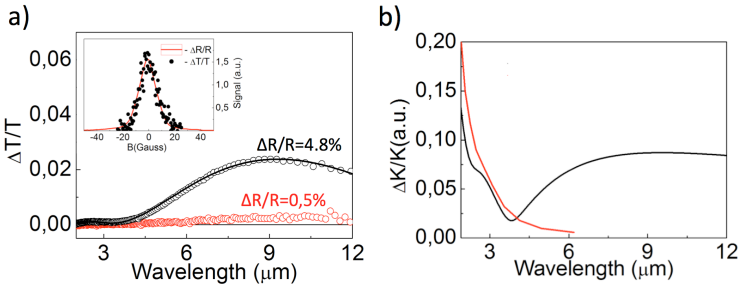


**Figure 1:** (a) Transmission spectra for two samples with different GMR values (4.8% and 0.5%). INSET: Magnetic field dependence of electrical resistance and integrated transmission in the mid IR region for the 4.8% GMR structure. (b) Calculated magnetic field modulation of propagating plasmons via MO effect (red) and MR effect (black). The modulation is similar for both MO and MR effects up to 3.5 μm, but it is much larger for the MR effect in the whole mid IR range.