# Spintronic-plasmonic metasurfaces for broad band infrared magnetic modulation

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We demonstrate experimentally and theoretically that metasurfaces consisting of arrays of randomly distributed plasmonic antenna (slits or rods) fabricated with $Ni_{81}Fe_{19}$/Au multilayers exhibiting Giant Magneto Resistance (GMR), show spintronic modulation of their optical properties in the mid infrared, using very weak magnetic fields [1, 2]. This is due to the change in the optical response induced by the magnetic field as a result of the Magneto Refractive Effect (MRE), enabling fast and contactless modulation of the optical properties in this spectral range. We find a continuous increase of the modulation of the optical transmission and reflectivity with both the antenna concentration and length. The increase in the antenna length leads to a red-shift of the plasmon peak position at which the modulation takes on, turning into an increase in the magnetic modulation towards longer wavelengths [3].
Furthermore, we show that the Babinet principle is fulfilled in rod-slit systems both in the optical response and the magnetic modulation.
These results open a route to design active metasurfaces covering different spectral regions (mid-far IR, THz, GHz...), by simply adapting the size and shape of the building blocks and their spatial distribution.

## References

[1] G. Armelles et al., Opt. Express, 25 (2017) 18784
[2] G. Armelles et al., ACS Photonics, 5 (2018) 3956
[3] G. Armelles et al., Nanophotonics, 8 (10) (2019) 1847

## Figures

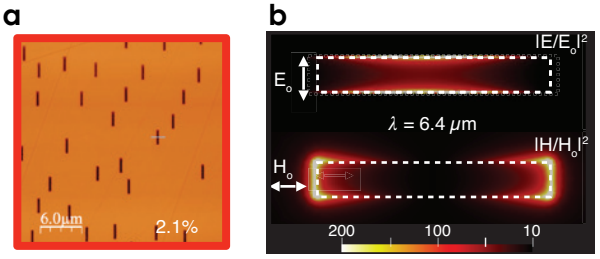


**Figure 1**: a) AFM image of fabricated random arrays of slits (2.1%, L=2μm). b) Electromagnetic field enhancement at plasmonic resonance in one slit of length L=2 μm.

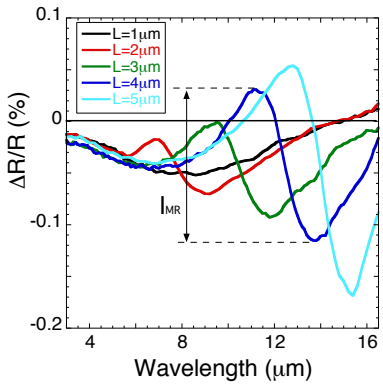


**Figure 2:** Magnetic modulation (change in the reflectivity without and with magnetic field along the slits, for slits of different lenghts. The incident light is polarized along the transverse axis of the slits.