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Electron dynamics in Fe3O4(100)/MgO(100) thin layer investigated by spin-resolved photoemission

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We present dynamics studies by spin-resolved photoemission (S-PES) experiments on magnetite (Fe3O4), a potentially spintronic suitable material. This ferrimagnet with a high Curie temperature has been theoretically predicted to be a half-metallic material with a conductive minority-spin channel and a semiconducting majority-spin channel, resulting in 100 % spin polarisation at the Fermi level (EF) [Z. Zhang and S. Satpathy, Phys. Rev. B 44, 13319 (1991)]. But the situation remains unclear on the experimental side. We used laser-based S-PES on ex situ prepared Fe3O4(100)/MgO(100) thin layers. The laser photon energy (6.2 eV) being close to the photoemission threshold only a narrow region near EF can be measured. However, only the low-lying Fe t2g d-bands (from EF to about 1 eV below EF) are of central interest. In "static"S-PES with 6.2 eV photon energy a change in the spin polarization sign is observed due to the presence of t2g minority band. Further details on this energy region are resolved by reducing the photon energy down to 4.6 eV. Dynamical studies show that the lifetime of excited electrons in Fe3O4 is much longer than in an "ordinary"metal. From the spin analysis of excited electrons we deduce that the demagnetization does not occur in the femtosecond range as it is the case for instance in Ni.

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