Conductance and noise in fully epitaxial magnetic tunnel junctions

F.G. Aliev[1], D.Herranz[1], A. Gomez-Ibarlucea[1], R. Guerrero[1], C. Tiusan[2], M. Hehn[2], and S. Andrieu[2]

1 Dpto. Física de la Materia Condensada, C03, Universidad Autónoma de Madrid, 28049 Madrid, Spain
2 Institut Jean Lamour, Nancy-Université -54506 Vandoeuvre Les Nancy Cedex, France

Magnetic tunnel junctions (MTJs) are nowadays one of the most active areas of material science and spintronics. Here, we review our recent studies of conductance and low frequency noise as a function of applied bias, magnetic state and temperature in different types of MTJs [1-4].
The shot noise measurements are used to resolve between direct and sequential tunnelling [1,2]. Fully epitaxial Fe/C/MgO/Fe(001) MTJs exhibit record low Hooge factors being at least one order of the magnitude smaller than previously reported [3]. Interface engineering by using Vanadium doping of Fe electrodes allows to relax misfit defects inside MgO barrier, dramatically reducing 1/f noise and enhancing tunnelling magnetoresistance [4]. Investigation of electronic transport in epitaxial Fe(100)/MgO/Fe/MgO/Fe double magnetic tunnel junctions with soft barrier breakdown (hot spots) [5] reveals quasi-periodic changes in the resistance as a function of bias voltage which point out formation of quantum well states in the middle Fe continuous free layer. Finally, we introduce "1/f noise band spectroscopy" to characterize band structure of ferromagnetic electrodes in MTJs involved in the spin dependent tunnelling.

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