Spin-injection through an Fe/InAs Interfaces

M. Zwierzycki[a,b], K. Xia[a], P.J. Kelly[a], G.E.W. Bauer[c], I. Turek[d]

[a] Faculty of Applied Physics and MESA+, University of Twente, The Netherlands

[b] Institute of Molecular Physics, P.A.S., Smoluchowskiego 17, 60-179 Poznan, Poland

[c] Department of Applied Physics, Delft University of Technology, The Netherlands

[d] Institute of Physics of Materials, Academy of Sciences of the Czech Repbulic, Brno

9.7 cm

Current interest in spin-injection into semiconductors is motivated both by the fundamental aspects of the phenomenon and by potential applications. The basic obstacle to spin-injection from a metallic ferromagnet into a semiconductor is the large difference in their conductivities; the resistivity of a semiconductor such as InAs is much larger than either the majority- or minority-spin resistivity of Fe. However, the spin-dependent interface resistance if sufficiently large could generate a spin-dependent potential drop at the interface. Here, we evaluate this term for an Fe/InAs interface from first principles. The formalism based on the tight-binding linear-muffin-tin orbital surface Green's function method allows us to treat large lateral superlattices so that we can study the influence of disorder on the conductance. We find that due to the symmetry mismatch in the minority-spin channel the specular interface acts as an efficient spin filter with the polarisation of transmitted current close to 100%. The resistance of a diffusive interface is comparable to the resistance of an InAs slab several hundreds nanometers thick but the symmetry breaking due to the disorder can substantially reduce the spin-asymmetry. We conclude that the spin injection for this system is possible only if the interface disorder is not too large.

13.4 cm

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Corresponding author :
M. Zwierzycki

Address for correspondence :
M. Zwierzycki
Faculteit der Technische Natuurkunde/CMS
Universitet Twente
Postbus 217
7500AE Enschede
Netherlands

Email address :
m.zwierzycki@tn.utwente.nl