Metal/2D Solid/Si study for spintronic application

Courtin Jules[1]
S. Le Gall[2], P. Chrétien[2], S. Tricot[1], G. Delhaye[1], B. Lépine[1], S. Abadou-Girard[1], S. Guézo[1], F. Solal[1], P. Turban[1], P. Schieffer[1] and J.-C Le Breton[1]
[1] *Département Matériaux et Nanosciences, Institut de Physique de Rennes, Campus de Beaulieu, Bât 11E, Rennes, France*
[2] *Laboratoire de Génie électrique de Paris 11, rue Joliot Curie Plateau de Moulon 91192 Gif sur Yvette Cedex*

jules.courtin@univ-rennes1.fr

The Spin-FET concept by Datta-Das, inaugurated years of research for spin injection into semi-conductor [1]. As shown by Fert and Jaffrès the control of tunnel contact resistance is the key point to obtain an efficient electrical spin injection from ferromagnetic metal into semi-conductor [2]. This control is hardly obtained with conventional oxides, due to the formation of defect states during oxide deposition [3]. The use of 2D atomic crystals (graphene, h-BN…) seems to be a promising way to avoid surface defects formation and control interface resistance.

We studied by x-ray photoemission spectroscopy and electrical characterisation (I(V) and C(V)) the electronic properties of metal/2D solid/ Silicon interface. By these methods we have shown that adding graphene at the interface induces a high reduction of Schottky barrier height compared to Metal/Silicon intimate contacts [figure1]. This ohmic-like behaviour is detrimental for electrical spin injection and detection [figure 2].

In addition to iron we studied the electronic transport properties of Au/2D Solid/n-Si and showed a similar behaviour. This results is of particular interest for the realisation of ohmic contact onto Si.

References

[1] S. Datta and B. Das Appl. Phys. Lett. **56**, 665 (1990)
[2] A. Fert and H. Jaffrès, Phys. Rev. B **64**,1 (2001)
[3] J.-C Le Breton et al, Appl. Phys. Lett **91**, 172122 (2007)

Figures

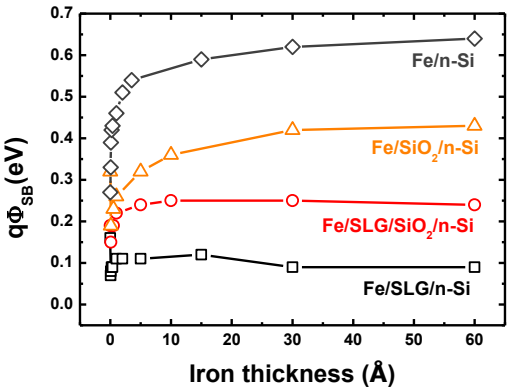

Figure 1: Schottcky barrier height as a function of iron thickness. These measurements have been realized with silicon doping at 10^{16} cm^{-3}.

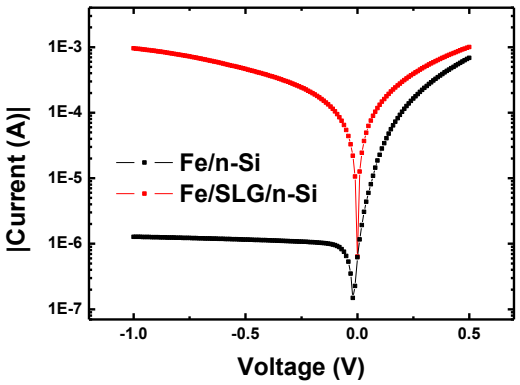

Figure 2: Current as a function of applied voltage with (red) and without (black) graphene at interface.