FIRST-PRINCIPLE GW+SO APPROACH TO THE STUDY OF SPIN RELAXATION TIMES OF EXCITED ELECTRONS IN METALS

Vladlen P. Zhukov, E.V. Chulkov, P.M. Echenique

Donostia International Physics Center
paseo Manuel de Lardizabal 4, 20018,
San Sebastian, Spain

waxvlvlj@ehu.es

Spin dynamics of itinerant electrons in metals and semiconductors is one of the paramount issues of modern spin electronics [1]. The first- principle evaluations of spin relaxation path and similar temporal characteristics of spin dynamics are important for the theoretical analysis and invention of new spintronic devices. We have developed an *ab initio* method of calculating the inelastic spin relaxation time of excited electrons in metals basing on the GW approach of many-body theory that incorporates spin-orbit coupling. We have studied the spin relaxation times and path's in Al, Cu, Au, Nb and Ta. The concept of spin-flip phase space has been introduced, and it has been shown that the trend in the values of spin-flip time, with respect to lifetime, is well described basing on this concept. The spin-relaxation time and path in Nb and in particular in Ta appear to be much less than that in Al, Cu, Au. Comparing our results and previous data associated with impurity-induced and phonon-induced spin relaxation times and path's, we find that at the energy about 0.9 eV, which is a typical energy of electrons in spin-valve and magnetic-tunnel transistors, the inelastic electron-electron scattering mediated by the spin-orbit coupling is the dominating mechanism of spin relaxation.

References:

[1] I. Zutic, J. Fabian, S. Das Sarma, Rev. Mod. Physics, **76**, (2004) 323.