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Spin-orbit fields at semiconductor interfaces[1]

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Solids without space inversion symmetry exhibit spin-orbit fields, which are emerging manifestations of spin-orbit coupling of the underlying atomic structure. Primary examples of spatially asymmetric systems are interfaces, which are omnipresent in electronic devices. As the device dimensions scale down, interfaces imprint their symmetries into the transport channel by proximity effects. Proximity spin-orbit fields already play important roles in anisotropic magnetoresistance of ultra-thin structures such as Fe/GaAs [1], in the physics of Majorana fermions [2,3] and Andreev reflection [4] of semiconductor/superconductor junctions, in Skyrmion textures [5] in ferromagnets, or in spin-orbit torques [6]. It is thus of vital interest to gain qualitative insight and realistic quantitative description of the interfacial spin-orbit fields for various materials hybrid settings. We have proposed a methodology to extract spin-orbit fields, both their magnitudes and directions, and applied it to investigate Fe/GaAs junctions [7]. Only at low momenta the traditional description of the fields in terms of linear Rashba and Dresselhaus works. At generic momenta the fields exhibit what we call butterfly patterns, conforming to the interfacial symmetry. Remarkably, the spin-orbit fields depend rather strongly on the magnetization orientation. We will also discuss our recent results on the spin-orbit coupling in zinc-blende and wurtzite semiconductor nanostructures.

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