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Spin transport across ferromagnetic tunnel contacts to semiconductors – questions and answers

RON JANSEN, National Institute of Advanced Industrial Science and Technology (AIST), Tsukuba, Japan

Ferromagnetic tunnel contacts to semiconductors are key building blocks of spintronic semiconductor devices. Such contacts allow the transport of spins from the ferromagnetic source into the semiconductor, driven either electrically or thermally, but also provide a means to detect spins in the semiconductor and convert the spin information into an electrical signal. Reproducible results have been obtained using either a local (3-terminal) or non-local (4-terminal) measurement geometry, and the electrical spin signals in both cases exhibit all the characteristic features of a current-induced non-equilibrium spin population. Nevertheless, the quantitative analysis has revealed surprising discrepancies with the existing theory. I will address several relevant questions about the nature of the spin transport in ferromagnetic tunnel contacts on semiconductors, and discuss the answers using the experimental observations that have been obtained over the last years and their comparison with available theories, including those involving localized states in the contact. The aim is to clarify what is established and understood and what is not, the latter pointing to interesting new physics yet to be uncovered.

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