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Giant spin signals in two-terminal ferromagnet/2DEG/ferromagnet spin-valve devices.[1]

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A ferromagnet/nonmagnet/ferromagnet (FM/NM/FM) structure constitute a basic spintronic device, with its two-terminal resistance depending on the spin state of the charge carriers. The primary example here is the Datta-Das spin field effect transistor (sFET)[2], with the nonmagnetic channel defined within a two-dimensional electron gas (2DEG) confined in a semiconductor (SC) structure. Efficient operation of such a device requires a large magnetoresistance signal, defined as $MR = \Delta R/R_P$, where ΔR is resistance difference between parallel (AP) and antiparallel (AP) configurations of magnetization in ferromagnetic source and drain contacts. In devices with semiconductor channels, however, measured MR signals are usually very low, well below 1%, because highly resistive tunnel FM/SC interfaces are required to succesfully inject spins into semiconductors.[3] In this talk I will present the results of our recent experiments on lateral FM/2DEG/FM devices with a 2DEG channel embedded at GaAs/AlGaAs interface and with ferromagnetic (Ga,Mn)As/GaAs Esaki diodes as source and drain contacts.[4] We observed very large two-terminal spin valve signals in such devices, with ΔR in order of 1kΩ and MR reaching even up to 80% in the region of the Esaki dip. I will discuss a strong bias dependence of the signal in terms of the effect of the electric field on the detection sensitivity of the ferromagnetic contacts. I will demonstrate also that the MR signal can be additionally tuned by means of an electric gate, used to modify a distribution of spin accumulation in the 2DEG channel.

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[2]S. Datta and B. Das, Appl. Phys. Lett. **56**, 665 (1990)

[3]A. Fert *et al.*, IEEE Transactions on Electron Devices, **54**(5), 921 (2007)

[4]M. Oltscher *et al.*, Phys. Rev. Lett. **113**, 236602 (2014)