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Spin transport in n-type Germanium epilayers at room temperature.

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Nowadays, Group-IV semiconductors spintronics is fast progressing field, with spin transport in some of its materials achieved even at room-temperature (RT) [1]. However, spin transport in germanium (Ge) is still limited at 225 K [2]. In this study we report realization of the RT spin transport in n-Ge using a spin pumping technique for spin injection, where the inverse spin Hall effect (ISHE) is used for detection of the spin current.

Spins were injected via the ferromagnetic resonance from a permalloy (Py) strip into the phosphorous-doped n-Ge substrate with doping concentration of 1.0×10^{19} cm^{-3}. After transporting through the n-Ge channel, spins were absorbed into a metal strip with a large spin orbit interaction, Me^{SOI} (palladium (Pd) or platinum (Pt) in our study). The spin orbit interaction in the Me^{SOI} enables to convert spin current to charge current. In order to estimate a voltage generated by the ISHE, we modify a model used in a bilayer magnetic/nonmagnetic structures [3] by taking damping of the spin current in the n-Ge into account. Comparing the calculated electromotive force in the model to the experimentally detected electromotive force from the Me^{SOI} strip, we estimated spin diffusion length in the n-Ge channel to be 650±200 nm at RT. Spin transport was realized through the n-Ge channel with the length in the range from 340 nm to 1510 nm. This is first experimental demonstration of the spin transport in n-Ge at RT [4].

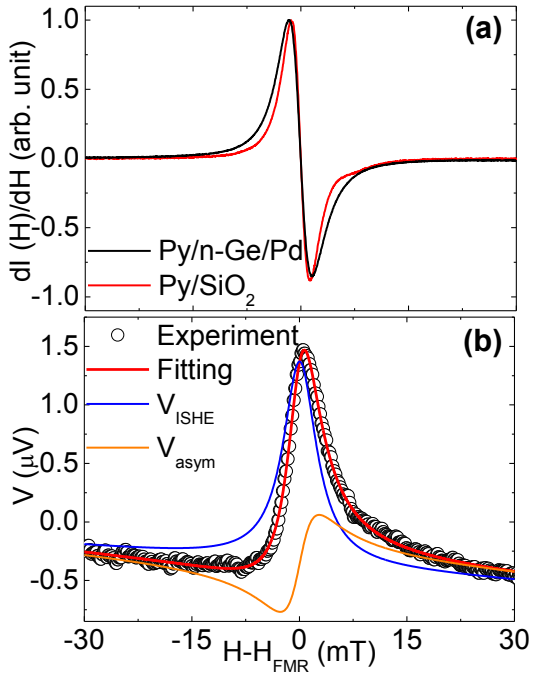

Fig. 1. Electromotive force generation under a FMR condition for a Py/n-Ge/Pd sample. Dependence of the in-plane external magnetic field, ***H***, of **(a)** a FMR signal, dI/dH, **(b)** an electromotive force, V, is shown.

References:

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