Ultrafast Electron Spin Dynamics Investigated by Optical Pump-probe Scanning Tunneling Microscopy

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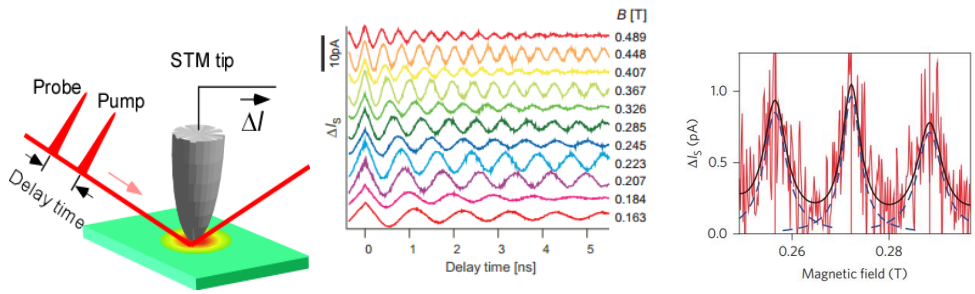
The understanding and direct measurement of ultrafast spin dynamics on nanostructure has always been an everlasting research topic both theoretically and experimentally during past decades. Several scanning tunneling microscopy (STM) based spatially resolved techniques, as well as the temporally resolved ultrafast spectroscopy methods had been successfully demonstrated to be powerful tools for characterizing localized nanoscale dynamics. Originally, here, we present the newly developed optical pump-probe STM (OPP-STM) technique, which enables us to probe ultrafast electron spin dynamics on semiconductors with both high temporal and spatial resolution at the same time.

Generally, electron spins are optically oriented using circularly polarized laser pulses and their dynamics can be probed by STM combined with the OPP method. In addition to spin relaxation dynamics, spin precessions, as well as the resonant spin amplifications are also observed for the first time ever on STM, which provide the lande's g-factor and the spin lifetime that longer than the laser repetition rate (90MHz, two synchronized femtosecond pulse lasers). What's more, spatial resolution is also attested to be less than 3nm in our OPP-STM.

The experimental setup and some of the results are shown in figure 1 below, more details and other results will be given and discussed in the poster presentation.



(a) (b) (c)

Fig.1. **(a)** The schematic of the OPP-STM. **(b)** The magnetic field dependence of spin precessions under the OPP-STM setup. **(c)** The resonant spin amplification result.

Reference:

[1]. S. Yoshida, et al. Probing ultrafast spin dynamics with optical pump-probe scanning tunneling microscopy. *Nature Nanotechnology. 9, 588-593 (2014)*