Coherent spin dynamics probed by Optical Pump-probe Scanning Tunneling Microscopy

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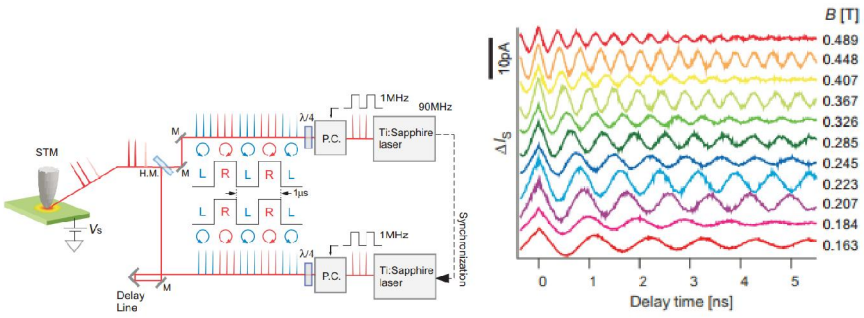
Recent years, the researches of spin dynamics in low dimensional nanoscale systems have grown rapidly and drawn more intentions than the past decades, both theoretically and experimentally. Several scanning tunneling microscopy (STM) based spatially resolved techniques, as well as the temporally resolved ultrafast spectroscopy methods had been successfully demonstrated to be powerful tools for characterizing localized spin dynamics. Originally and complementarily, here, we present our newly developed optical pump-probe STM (OPP-STM) technique, which enables us to probe the spin dynamics on nanoscale with both high temporal and spatial resolution. In general, electron spins are optically oriented using circularly polarized laser pulses and their dynamics are probed by STM combined with the OPP method (Fig.1a). In addition to spin relaxation dynamics, spin precessions are also observed for the first time ever on STM (Fig.1b), which provides Landé's *g*-factor and the spin lifetimes, what's more, spatially resolved performance is also tested.

More details and other results will be given and discussed in the poster presentation.



(a) (b)

Fig.1. ***(a)*** *The schematic of the OPP-STM. P.C is the pockels cell used to modulate the polarization states.* ***(b)*** *The magnetic field dependence of spin precessions under the OPP-STM setup, the spin precession occurs at the Larmor frequency $\omega=g\mu_B B/\hbar$, where g is the Landé's g factor, B is the magnetic field, μ_B is Bohr magneton and $\hbar$ is Dirac constant.*

References:

1. Yoshida, S., Aizawa, Y., Wang, ZH., Oshima, R., Mera, Y., Matsuyama, E., Oigawa, H., Takeuchi, O & Shigekawa, H. *Probing ultrafast spin dynamics with optical pump-probe scanning tunneling microscopy.* **Nature Nanotechnology, in press**

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