Effect of tip thermal expansion in laser combined STM

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In the past decade, with the rapid development of semiconductor industry, Moore's law has almost reached its limit. For the purpose of future semiconductor device refinement and applications of quantum computation, a comprehensive understanding of nanoscale electron dynamics is in quite crucial. Our group, led by Prof. Shigekawa at University of Tsukuba, had successfully developed a new measurement technique that can be used to observe nanoscale carrier and spin dynamics with both high temporal and spatial resolution simultaneously, which is named as Optical Pump-probe Scanning Tunneling Microscopy (OPP-STM). Briefly speaking, it is a state-of-the-art microscopic measurement technique that combines STM with ultrafast laser spectroscopy. Some ground-breaking experiments on LT-GaAs carrier dynamics as well as GaAs ultrafast electron spin dynamics had been successfully done by our OPP-STM system.

In our OPP-STM system, STM tip apex is illuminated by pulse laser. Usually Tungsten tip is utilized and the thermal expansion&shrinkage effect brings unwanted noises during measurements. To reduce those noises, gold particles are deposited on the tip surface, thus, compared with Tungsten tip, gold-coated tip with good reflectivity will bring us less noises since absorption is very much suppressed.

In this presentation, I will show results on the differences between Tungsten and gold-coated tip in terms of signal strength by measuring tunneling current from gold sample and time-resolved Surface-Photo-Voltage (SPV) in undoped GaAs(100). Experimental details will be introduced in the poster presentation.

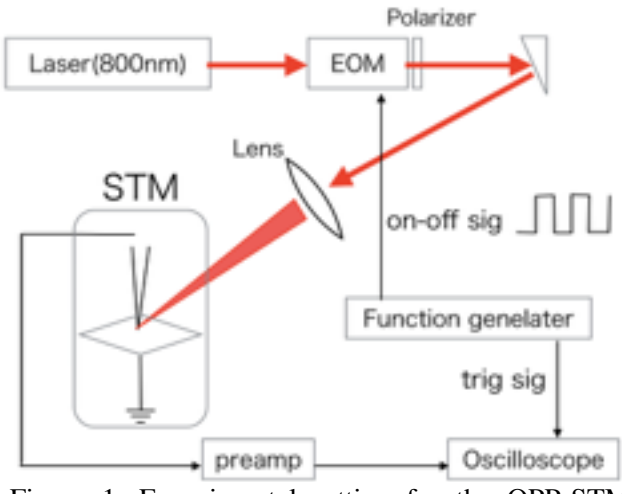

Figure 1. Experimental setting for the OPP-STM experiment, laser pulses are modulated by Electric-Optic-Modulator (EOM)

References:

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