Transient Dynamics of Low-dimensional TMDs Observed by Multi-probe Optical Pump-probe Scanning Tunneling Microscopy

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Transition Metal Dichalcogenides (TMDs) have become quite a hot topic in physics and chemistry both theoretically and experimentally in the past few years. Some of the representative 2-dimenional TMDs, such as monolayer MoS_2, has intriguing electronic and optical properties. Moreover, rich application potentials of TMDs in various field including micro-electronics, valley-tronics, as well as energy scavenging, have also been unambiguously acknowledged. Here we present a time-resolved Scanning Tunneling Microscopy (STM)-based measurement technique, to probe the transient dynamics in MoS_2 thin films, which potentially enables us to observe the transport properties or interface dynamics of TMDs and its nanostructures[1] exclusively.

The time-resolved STM, namely, the Optical Pump-probe STM (OPP-STM) that we have originally developed, combines the well-known ultrafast pump-probe technique and STM together. Different from the single-probe OPP-STM which we previously proposed[2], this time, we proceeded to build a multi-probe OPP-STM that is able to probe the transient dynamics between two (or more) probes, that is to say, observing spatially resolved carrier or spin dynamics with transport properties have become possible on STM. The sample we use is few-to-monolayer MoS_2 on Boron Nitride substrate. All experiments are performed at 300K. The illustrative experimental setup is shown in figure 1, in which the tunnel current is flowed from one tip to the other with the substrate floating. Empowered by this setup, transient carrier dynamics of our MoS_2 was successfully obtained. Details of the experimental design as well as more results will be reported in the presentation.

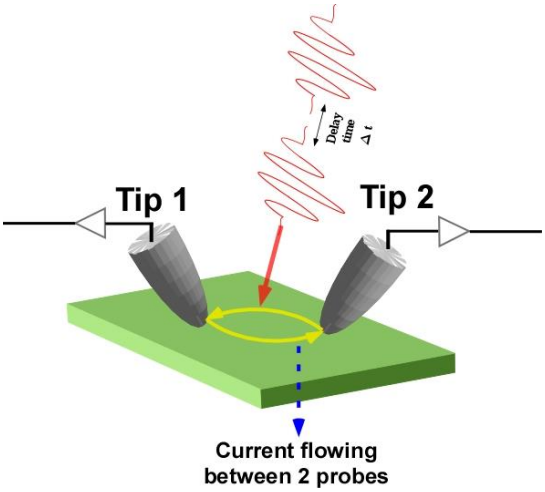

Figure 1. Schematic illustration of the Multi-probe OPP-STM, tip1 and tip2 can be a combination of AFM cantilevers and STM Pt/Ir tips.

References:

[1] Y. Kobayashi, et al. *Scientific Reports 6,* 31223, 2016.

[2] Y. Terada, et al. *Nature Photonics 4*, 12, 869-874, 2010.