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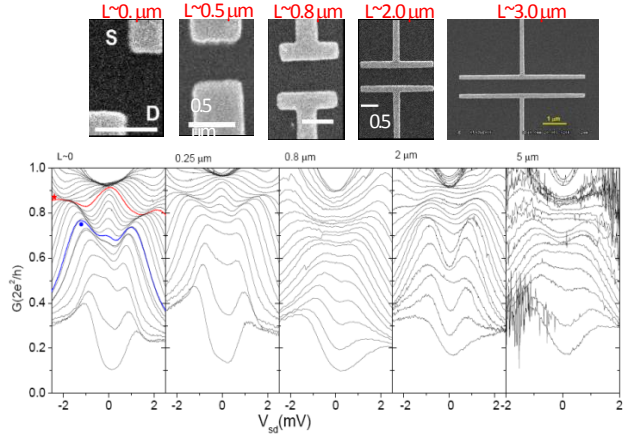
Mesoscopic transport phenomena, Low temperature physics, sub-micrometric patterned devices, spintronics

We are "Mesoscopic Magneto-transport Research Lab" of the Electrophysics Department, NCTU. Our scanning electron microscope equipped with nano-pattern generation system has capacity to fabricate sub-micron structures. Various cryogenic systems of temperature 35mK~300K and magnetic field 0~9T allow us to perform the magneto-transport measurements. Our primary research interests include the following two major parts:

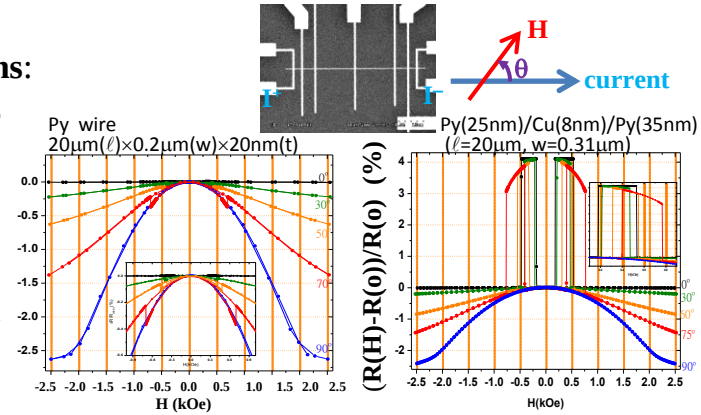
(a) Magneto-transport studies in gate confined quantum devices :

The two dimensional electron gas which forms at the interface of an $Al_xGa_{1-x}As/GaAs$ heterostructure was grown by MBE of Dr. Umansky at Wiezman institute in Israel. With the nano-pattern fabrication and advanced measurement techniques, numerous topics related to quantum transport in gate-confined nanostructures have been investigated to explore the scattering and interference effects for recent years. For instance, the source-drain bias spectroscopy of quasi-one dimensional clean quantum wires (QWs) against structural geometry is shown on the right. We found that conductance quantization and the zero bias anomaly (ZBA) are robust in clean QWs. The increase in channel length introduces additional scattering of conduction electrons resulting in the enhanced electron-electron interactions and correspondingly, a diminished ZBA.



(b) Magnetization reversal studies in sub-micrometric patterned magnetic systems:

The magnetoresistance(MR) of some sub-micrometric magnetic systems (single wires or spin valves) with different geometries have been studied to explore their magnetization reversal. For instance, the left panel exhibits that the discontinuity jump in in-plane magneto-resistances occurs at the switching field characterizing the curling mechanism. The reversal in the single domain Permalloy planar wire is finished via a local nucleation resulting in a sudden switching. Meanwhile, a tri-layer device demonstrates the giant and anisotropic MR behaviors as shown in the right panel.



Key Facilities: Helium 4 cryostats, Helium 3 cryostat, ^3He–^4He dilution refrigerator, Superconducting magnet, Electromagnet, Scanning electron microscope, 4-source thermal evaporator, sputtering system, several low noise/high precision electrical measurement systems for IV characteristics, differential conductance, …etc.