Scanning Tunneling Potentiometry/Spectroscopy with Multi-Probe STM

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Recently, apart from the ultraclean semiconductor devices, devices made of inhomogeneous or granular materials are diligently studied. For example, conductive ink containing soluble metallic nanoparticles made it possible to fabricate micro-circuits mechanically printed by conventional press machine on flexible substrates in the absence of thermal tolerance. Such new materials have novel functions but they tend to have lower electrical conductivity than the conventional pure materials. To improve the performance, it is important to investigate electrical conductivity and charge transport in the new materials in nanometer scale. For this purpose, we developed a multi-probe scanning tunneling microscope (STM) that can measure both scanning tunneling potentiometry (STP) and spectroscopy (STS). Figure shows the measurement concept. During STM topography measurement, scanning is interrupted on the grid points and measurement mode is switched between the current mode and the potentiometry mode. STP with a few tens of microvolt resolution is demonstrated. We report the technical detail of the microscope and the recent application results.

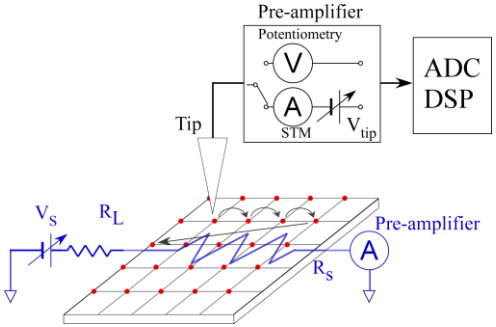

Figure: Schematic diagram of the experimental setup.