Equipment Development Center

VIII-T Development of "Special Machine"

The technical staff of the Equipment Development Center is partly engaged in planning, researching, designing and constructing "Special machine." This machine, is a high-tech experimental instrument, with emphasis on new technical idea and co-operative work with members inside and outside the Institute including those in industries. We collect suggestions of new instruments once every year from Professors and Associate Professors of IMS.

In this fiscal year, 2001, one project theme was adopted as Special machine.

VIII-T-1 Development of Twin-Probe Scanning Tunneling Microscope

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It is important to study electrical properties of materials in nm scale for the construction of electronic devices in the same scale. Scanning probe microscopy (SPM) is one of the most powerful methods to measure local properties of solid surfaces in nm ~ atomic scales. Most of the SPM uses a single probe and, therefore, it is difficult to measure the transport properties of nanoscale structures.

We constructed a twin probe scanning tunneling microscope which has two independently driven probes. By using this instrument, it is expected to be possible to measure electrical transport properties such as resistance as a function of a distance between two probes in nano-scale.

The whole instruments were placed on a spring damper to be isolated from the mechanical vibrations. Two tube piezos which were used for the fine adjustment of the tip positions were fixed beneath steel beams. The beams were placed on commercially available microstage (Melles Griot) used for coarse adjustment of the tip positions. A current-to-voltage converter with a sensitivity of 1 nA/V was fabricated. It is used to measure a current flowing between the probe and the sample and that flowing between the each probe when the bias voltage is applied to the sample and one of the probes, respectively. The measured current was fed into the commercially available SPM controller (JEOL) and surface morphology was obtained by scanning the probe in *x-y* plane by the tube piezos keeping the current constant by controlling the *z* position of the probe.

Figure 1 shows an image of HOPG surface obtained by the instrument. Atomically flat terraces and mono-atomic steps were imaged independently by two probes at the same time. We are now optimizing the resolution and fabricating a sharper tip to get two probes closer each other.

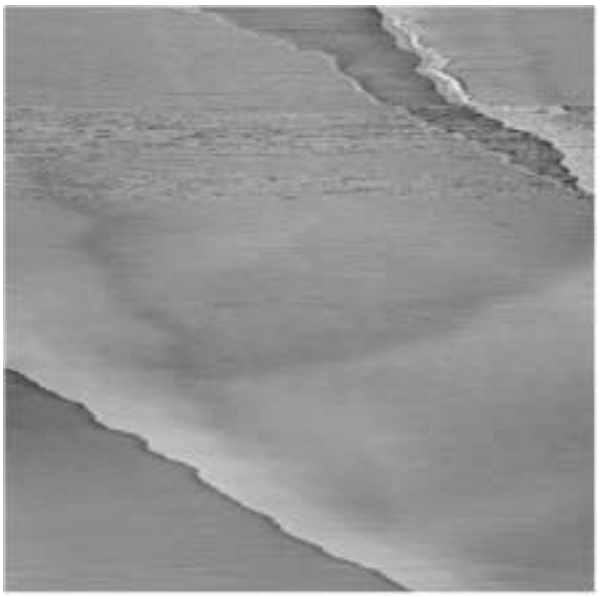

Figure 1. An STM image of HOPG surface.