Poster

Development of a low-energy electron diffraction using field emission from STM tips

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Low-energy electron diffraction (LEED) analysis is one of the most powerful tools for the determination of surface structures. However, the usual LEED analysis cannot be applied to the study of nanometer-scale structures or small domain structures, because of the macroscopic size of the incident electron beams. We are in the process of developing a new LEED apparatus using STM tips as a field emission gun [1,2]. The field emission from STM tips has the potential to probe small surface areas with electron beams. Several groups have demonstrated their capabilities [3-7].

A schematic illustration of the apparatus is shown in Fig. 1. The apparatus was designed to detect scattered electrons toward the surface normal direction using a tip shield and an extractor. The sensitivity and stability of the apparatus seem sufficient while certain diffraction patterns of surface structures have not yet been obtained. The obtained scattering patterns showed two bright regions. The kinetic energies of the scattered electrons were measured for each bright region using retarding grids. The outer bright region (circles) has a sharp peak at 70 eV as shown in Fig. 2(b). It means that the outer bright region is mainly consisted by elastically scattered electrons. On the other hand, the inner bright region (squares) has a peak around 40 eV and is consisted by inelastically scattered electrons. The behavior of the outer bright region was consistent with our simple calculations if the electrons were scattered elastically at the sample surface. These results support the possibility of the LEED using STM tips as a field emission gun. The apparatus had a feature of the high-pass filter even though we did not use retarding grids. This feature is suitable for an LEED apparatus. Further improvement will be discussed.

References

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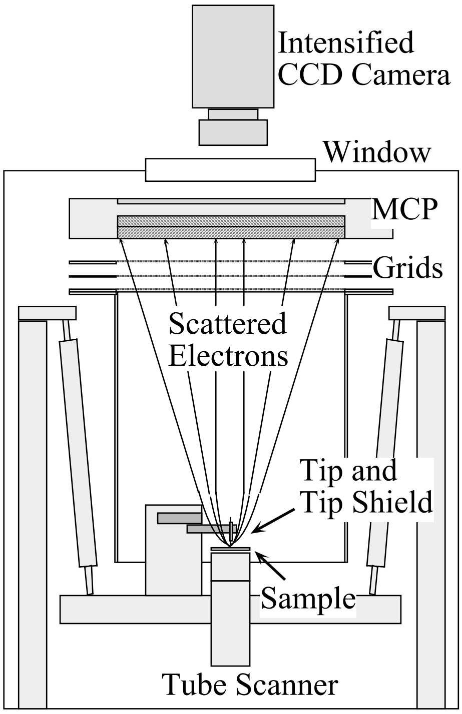

Fig. 1. Schematic illustration of the experimental LEED apparatus using STM tips as a field emission gun.

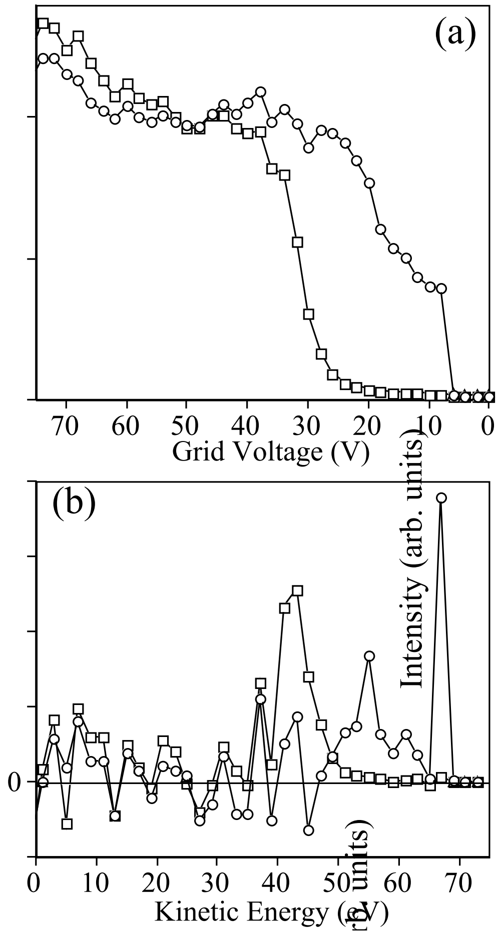

Fig. 2. (a) Intensity vs grid voltage. Circles and squares are the integrated intensities of the outer and inner bright regions, respectively. (b) Differential curves of (a). The horizontal axis is replaced by the kinetic energy at the sample surface.