Imaging of Mica and Graphite Surfaces With the Laser-AFM*

WU Jun-Han (吴浚瀚)**, CHENG Ying-Jun (成英俊)***, DAI Chang-Chun (戴长春)***,
HUANG Gui-Zhen (黄桂珍)***, XIE You-Chang (谢有畅)****,
GONG Li-San (龚立三)** and BAI Chun-Li (白春礼)***,*****

Received April 8, 1993.

Keywords: mica, graphite, surface, laser, AFM.

In 1986, Binnig *et al.* developed the first atomic force microscope (AFM)[1]. The AFM, unlike the scanning tunnelling microscope (STM), has no demands for electrical conductivity, so it has been used in science and technology more widely. In 1988, the AFM was improved, and the AFM employing laser beam deflection for force detection (laser-AFM) was developed[2—4]. In 1990, laser-AFM got the atomic-resolution[4]. Up till now, the AFM has developed into a very important technique for studying the surface.

On the basis of our previous STM and AFM[5,6], we have developed the first atomic-resolution laser-AFM of China[7].

Mica, a natural layer crystal, has good insulating ability, heat conductivity and chemical stability. It can be cleaved to get a clean cleavage surface conveniently; besides, the atoms on cleavage surface are arranged in a characteristic hexagonal array, so it is used for examining the performance of the AFM regularly. There are fewer defects on the cleavage surface of mica, and a large-scale plane is easy to get, so it is the most common substrate in studying absorption materials. Because of its insulating property, mica must be plated with metal film before being examined by STM, so it could not be imaged directly.

Figure 1 is an AFM grayscale image of mica with the characteristic hexagonal array of rings[8]. In Fig. 1, the distance between the centers of two adjacent hexagonal arrays is 0.51 nm, which tallies with the results of crystal diffraction.

Graphite is a layer crystal made from carbon atoms. Fig. 2 is an AFM three-dimensional image of highly oriented pyrolytic graphite (HOPG). In this image, the atoms at A-site and B-site can be resolved, and the distance between adjacent A-sites is

* Project supported by Academia Sinica.

** Molecular Biotech Research Center, South China Normal University, Guangzhou 510631, PRC.

*** Lab of STM, Institute of Chemistry, Academia Sinica, Beijing 100080, PRC.

**** Department of Chemistry, Peking University, Beijing 100871, PRC.

***** To whom correspondence should be addressed.

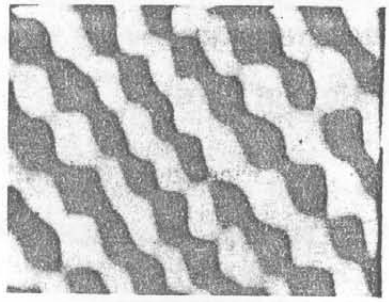

Fig. 1. AFM grayscale image of mica (3 nm × 3 nm).

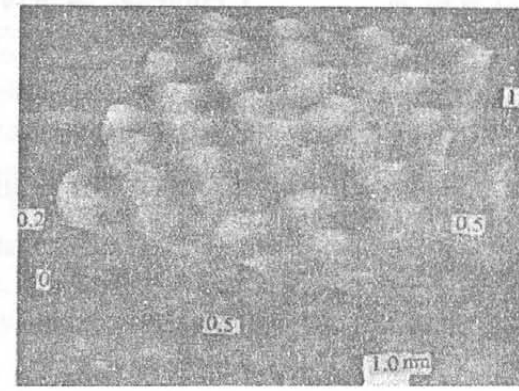

Fig. 2. AFM three-dimensional image of graphite (1 nm × 1 nm).

0.25 nm. It is identical with the results of crystal diffraction and STM.

In addition, we have obtained the images of disks, tobacco mosaic virus (TMV) deposited on the surface of mica, recombinant polypeptide and the two-dimensional polycrystalline structures of polystyrene (PSt) latex particles with our laser-AFM.

We thank P. S. Wang, R. L. Li, P. C. Zhang, Y. Xia, Y. Fang, Z. H. Wang and others in Lab of STM, Institute of Chemistry, Academia Sinica for their assistance in our research.

References

1 Binnig, G., Quate, C. F. & Gerber, Ch., *Phys. Rev. Lett.*, 1986, 56: 930.
2 Amer, N. M. & Meyer, G., *Bull. Am. Phys. Soc.*, 1988, 33: 319.
3 Meyer, G. & Amer, N. M., *Appl. Phys. Lett.*, 1988, 53: 1045.
4 Alexander, S., Hellemans, L., Marti, O. *et al.*, *J. Appl. Phys.*, 1989, 65: 164.
5 Bai, C. L., *Chinese Science Bulletin*, 1989, 34: 399.
6 Bai, C. L., *Bull. Academia Sinica* (in Chinese), 1990, 5: 340.
7 Wu, J. H., Cheng, Y. J., Dai, C. C. *et al.*, *Chinese Science Bulletin*, 1993, to be printed.
8 Hartman, H., Sposito, G., Yang, A. *et al.*, *Clays and Clay Minerals*, 1990, 38: 337.