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STM Observation of Atomic Structure of 2H-$NbSe_2$

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The atomic structure of 2H-$NbSe_2$ was successfully observed with a scanning tunneling microscope (STM). The STM apparatus developed here showed resolutions of 0.3 nm in the lateral scale and 0.05 nm in the vertical scale.

In these days, the crystal growth techniques such as MBE of semiconductors become highly developed so as to control each atomic layer. In addition, the biological substances such as protein become of potential importance, e.g., for new electronic materials. To develope a tool for observing the surface structures of these materials with atomic resolution and without causing any damages, we have constructed an STM apparatus, originally developed by Binnig et al.,[1] by taking care of several basic key technologies: vibration isolation, micropositioners[2], control circuit, etc. And we observed the surface atomic structure of 2H-$NbSe_2$ single crystal by the apparatus.

We selected 2H-$NbSe_2$ single crystal as the sample. This material is regarded as an ideal object for the test of STM performance since it is inert and free from adsorption even in air and possesses large atomically flat planes. In Fig. 1. we show a typical STM image of as-grown sample, top view of brightness map with light coming from 45° direction off the surface. The height of corrugation in the z-direction corresponds to 0.4 nm. The tunneling current was locked to 3 nA and the bias voltage applied to the tip was -10 mV with respect to the sample. We clearly see the trigonal pattern of the atomic structure shown by lines in Fig. 1, which is consistent with the

published data.

In conclusion, we have successfully constructed STM by taking care of basic key technologies. The STM developed here provides good atomic image of 2H-$NbSe_2$ surface and exhibits resolutions of 0.3 nm in the lateral scale and 0.05 nm in the vertical scale. When the STM is combined with the crystal growth system, e.g., MBE, the control of atomic level become possible during crystal growth.

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1) G. Binnig et al.: Appl. Phys. Lett. 40 (1982) 178.
2) S. Okayama et al.: Jpn. J. Appl. Phys. 24 (1985) Suppl. 24-3, 152; H. Tokumoto et al.: to be published in Jpn. J. Appl. Phys. (1986).

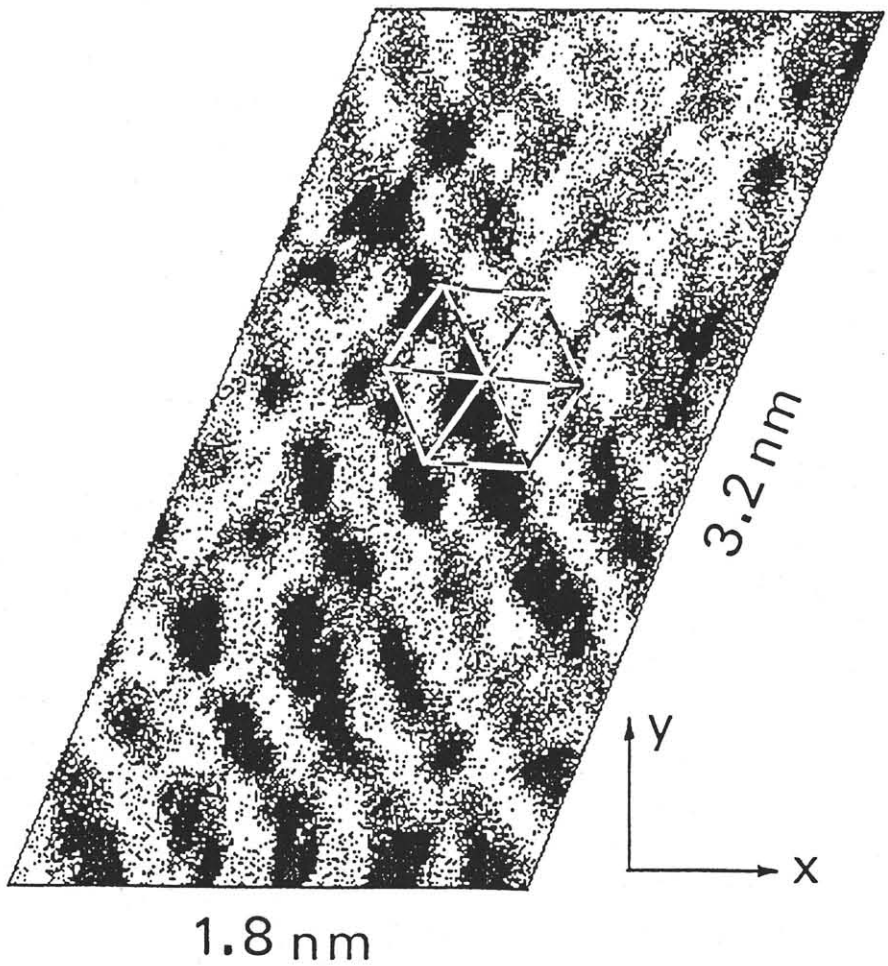

Fig. 1. STM image of 2H-$NbSe_2$