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Scanning Tunneling Microscopy Studies of the MoS_2 Surface

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We present the results of scanning tunneling microscopy (STM) study on the natural MoS_2 surface. STM was operated in air in a constant height mode. The atomic resolution image with the hexagonal symmetry of the crystal surface was routinely observed. A large-area image of MoS_2 reveals some characteristic structures such as protrusions and ring-type structures with a ring diameter of about 50 Å on the surface. We have taken STM images with variation of the tip bias voltage ranging from -200 meV to -550 meV.

It is also observed that the intensity of ring-type structure and other background patterns with irregular shape are strongly dependent on tip-bias voltages. In order to understand the origin of ring-type structure observed on MoS_2 surface, the impurities in the sample were analyzed. Voltage-dependent changes of STM images and the presence of impurities in the sample suggest that the ring-type structure is expected to appear as a result of competition between the negatively and positively charged acceptors located together in one local area. Our observation strongly indicates that the ring-type structures are originated from the electronic effect due to impurity doping in the MoS_2 layer.