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How Atoms Behave--Investigate the Surface with STM!

Semiconductors play a crucial role in daily electronics, such as computers, mobile phones, and solar cells. Nowadays, people cannot live without these electronics, especially computers. With the increasing demand for high-speed computers, quantum computers are proposed as the computers of the next generation. However, the making of the suitable material becomes a problem.

Semiconductors composed of group III and group V elements (III-V compound) are considered to have adjustable and diverse properties. Thanks to researches done by scientists, it is found that bismuth (Bi)-containing III-V compounds are potential materials for quantum computers. Nevertheless, since Bi is the largest atom among group V elements, it is difficult for Bi to incorporate in to the host III-V material. Thus, fabricating high quality III-V-Bi materials becomes the field that needs more studies and efforts.

Taking seats on the surface

To take part in this research field, we studied the Bi adsorption behavior. We chose indium arsenide (InAs) as the host material, and deposited Bi atoms on the InAs(111)B surface. With different amount of deposition, we expected to see distinct Bi arrangements on the surface. Just imaging that there are many available seats on the InAs(111)B surface, with some of them more favored by Bi. If there are bunches of incoming Bi atoms, some of them inevitably sit on the sites that are less preferred. To further observe the Bi behavior on the InAs(111)B surface, we heated the sample after the deposition. By raising the temperature, Bi atoms can possess enough energy to diffuse around, find their comfortable seats, or even leave the surface.

See tiny blocks of all the matters

The most important part of the experiment is to see Bi atoms on the surface. Atoms are blocks that build up all the matters in the universe, yet they are so small that they cannot be easily seen. For example, stacking one million atoms in a row has the same thickness as a sheet of paper. Scanning tunneling microscopy (STM) is a powerful imaging technique that is able to visualize these tiny blocks on the surface. A STM image is mapped based on the tunneling current, which is an effect that only occurs in microscopic scale. The tunneling current is very weak but surface-sensitive. Even a tiny bump of an atom can be detected by STM.

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