Energy-dependent Scattering Phase-Shift of Electrons in 2D Subband States.

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Abstract

In order to propose a phase-operation technique for conduction electrons in solid, we have investigated an atomic-scale scattering phenomenon on a 2D subband state formed in a space charge layer of Si by using STM.

Measurements were performed with Si(111)-β-√3x√3 Bi surface [1]. Particularly, we have noticed a single surface point-defect around which a standing wave pattern was created (Fig. 1), and a dispersion of scattering phase-shifts by the defect-potential against electron-energy has been measured [2].

The behavior is well-explained by a simple 1D model with appropriate scattering parameters: the potential height and radius, which were estimated 0.62 eV and 0.59 nm, respectively (Fig. 2). To obtain these numerical values of the detail scattering parameters is a fundamental process toward phase-shift operation by the electron scattering in a solid. Therefore this result is useful for designing quantum devices utilizing the wave nature of electron, such as a quantum logic device.

References

[1] K. Nagaoka, S. Yaginuma, & T. Nakayama, ***submitted.***
[2] K. Nagaoka, S. Yaginuma, & T. Nakayama, ***submitted.***

Figures

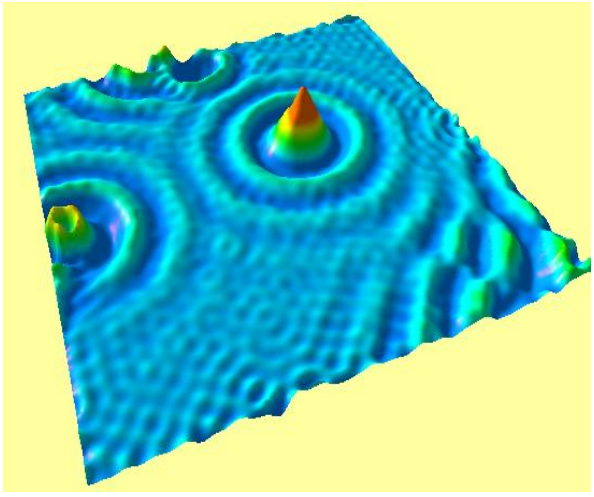

Fig.1 dI/dV image around the point defect at Vs=1.4 V; 20 x 20 nm^2

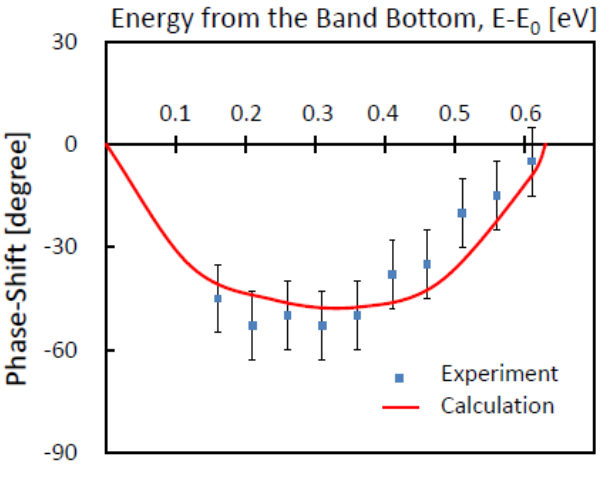

Fig. 2 Experimental scattering phase-shift dispersion as a function of the energy from the subband bottom.