Tip-induced surface relaxation and short-range interaction studied by Non-contact Atomic Force Microscopy imaging of GaAs(110) Surface

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High sensitivity of atomic force microscopy (AFM) originated from short-range chemical forces has revealed various kinds of surface structures including insulative materials [1]. And its high spatial resolution enables one to manipulate a single atom on surfaces. The short-range chemical forces are the forces acting between atoms on a tip apex and on a sample surface, which becomes obvious by reducing background forces due to long-range atomic interactions [2]. Since the short-range chemical interactions are sensitive to bonding sates of the tip apex, details of AFM images depend upon the states. We have been investigating GaAs (110) surfaces by means of the non-contact AFM (NC-AFM) technique and demonstrated that a Si-terminated tip gives images that consist of two kinds of protrusions, i.e. Ga and As related protrusions [3]. Furthermore, we have discussed tip-sample distance dependence of the AFM images in which both Ga and As related sites are observed, and we have observed tip-induced relaxation of surface atoms [4].

In our previous studies, we have observed AFM images of GaAs(110) surfaces as a function of a frequency shift that is a parameter to maintain measurement condition related to the tip-sample distance. In this reports, to compare experimental results and theoretical studies, we observe the AFM images of GaAs(110) surface as a function of tip-sample distance and estimate normalized frequency shits. In addition, we investigate short-range interaction around a point defect.

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