Simultaneous qPlus NC-AFM and STM of Silver-Terminated Si(111): triskelions, trimers and tips

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The silver-terminated silicon surface, Ag-Si(111)-(√3x√3)R30 (Ag-√3) has been extensively investigated by scanning probe techniques. Although it is now accepted that the ground state of the surface is best described by the inequivalent trimer (IET) model, the contrast mechanism in SPM remains controversial due to the strong influence of the tip state in both STM [1] and NC-AFM [2-3]. In particular theoretical studies have failed to accurately reproduce the observed setpoint dependence (triskelions to trimers) in NC-AFM studies of Ag-√3 at room temperature [4].

By operating a Omicron qPlus NC-AFM/STM in constant frequency shift feedback and acquiring tunnel current simultaneously, we are able to unambiguously determine the origin of the features in NC-AFM by comparing the proposed STM and AFM contrast mechanisms. We show that both the Si-Ag bonds and Ag atoms are imaged depending on tip termination. We also demonstrate that NC-AFM successfully resolves the IET structure at low temperature, and uniquely, can determine the absolute chirality of the surface.

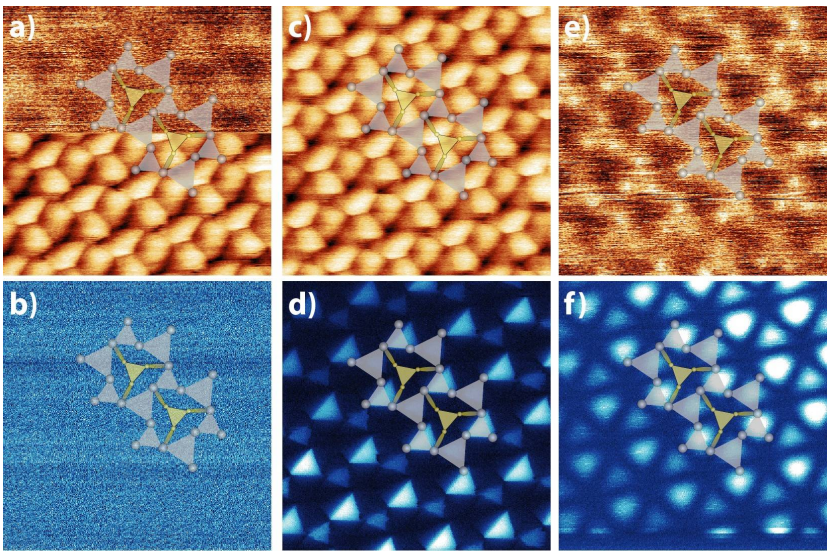

Figure 1. *Simultaneous AFM (top row) and STM (bottom row) of the Ag-Si(111)-(√3x√3) surface at 5K.* ***a)*** *Tip change showing switch from "Si-Ag bonds" to "Ag atoms" contrast. Applied bias ~0V,* ***b)*** *Simultaneous I_t showing no contrast.* ***c)*** *Image of same area showing "Si-Ag bonds" contrast (~150mV applied bias).* ***e)*** *Image in same area showing "Ag atoms" contrast (~170mV applied bias).* ***d) & f)*** *Simultaneous I_t for c) and e) respectively, showing IET structure. In each image the IET surface structure is overlaid.*

References

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