

Strain induced quasi-one dimensional structure of rare earth silicides on Si(111)

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One dimensional (1D) systems attract a lot of attention since their physical properties are distinctively different from structures of higher dimensionality. For instance, this kind of structures is realized by metal induced quasi-1D systems on Si(111) due to deposition of, e.g., Au or In. Recently, we observed a new quasi-1D rare earth silicides (RESi) structure induced by RE deposition at elevated temperature forming a $(2 \times 3 \times 3)$ superstructure. This quasi-1D structure differs from a large number of other planar 2D structures reported before [1,2].

Here, we report on combined studies by means of scanning tunneling microscopy (STM), spot profile analysis of low-energy electron diffraction (SPA-LEED), and density functional theory (DFT) to analyze the complex structure of the Si(111)- $(2 \times 3 \times 3)$ -RESi structure. [3,4]. Our analysis shows that the $(2 \times 3 \times 3)$ structure is attributed to the formation of periodically arranged Si vacancies in different subsurface silicide layers. The complex structure of this superstructure with buckled surface layer, 3×3 superstructure in the first subsurface layer, and $2 \times 3 \times 3$ superstructure in the second subsurface layer could only be analyzed applying the different techniques used here. The anisotropic character of this structure is emphasized by the formation of periodically arranged domain boundaries. The width of the silicide domains formed in two domains is roughly two unit cells.

References:

- [1] S. Sanna et al., Phys. Rev. B93, 195407 (2016).
- [2] M. Dähne et al., J. Phys. Condens. Matter 25, 014012 (2013).
- [3] F. Timmer et al., Phys. Rev. B94, 205431 (2016).
- [4] F. Timmer et al., Condens. Matter 2 (2017) 7.

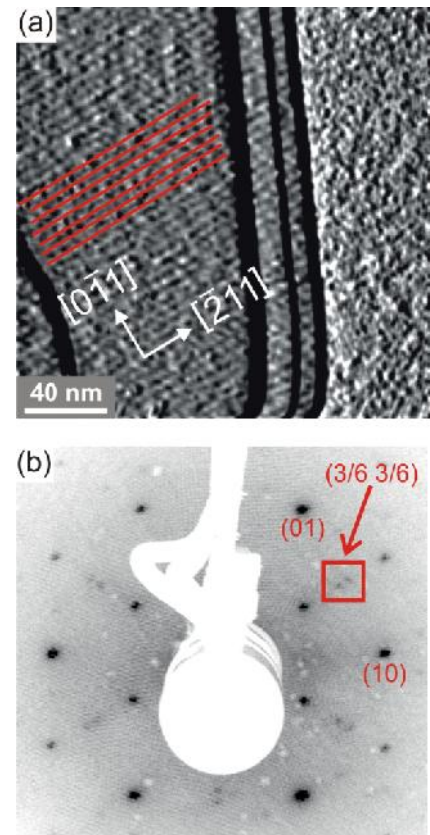


Fig. 1. Si(111)-RESi₂-($2\sqrt{3} \times \sqrt{3}$)-RESi. (a) STM micrograph showing quasi-1D structures. (b) LEED picture with split diffraction spots, e.g. a $(3/6, 3/6)$ peak.