Nanostructured surfaces

Subtle long-range nanostructuring of the Au/Ru(0001) surface

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The Au(111) surface of the bulk sample exhibits a rather unique $22\times\sqrt{3}$ reconstruction, which is now well understood in terms of atomic structure and electronic properties [1]. It shows a rich variety of structural features [2] leading to essentailly self-induced nanostructuring of the surface, usually reffered to as so-called herring-bone reconstruction.

Thin film samples of Au(111) can experience mechanical stress due to lattice constant mismatch with the supporting substrate, which can possibly influence the type of surface reconstruction. In this work we report the observation by means of scanning tunneling microscopy (STM) of the new surface reconstruction of 10 mono-layer Au film grown on the pure Ru(0001) substrate at 300 K with subsequent annealing at 1050 K (all procedures performed in ultra-high vacuum).

Detailed STM images with atomic resolution demonstrate the 5.3 nm × 5.3 nm supercell of the new reconstruction with the maximum height modulation of the surface layer atoms of 0.03 nm. We speculate that the driving force of departure from the Au(111)-$22\times\sqrt{3}$ superstructure is the compressive strain experienced by the film due to in-plane constant of Ru(0001) equal to 0.271 nm being smaller than 0.288 nm for Au(111) bulk. We observe a uniform coverage of the substrate by the continuous atomically flat film, thus ruling out any stress relaxation by means of 3D islands growth or any other non-wetting behavior.

A tentative atomic model of the new surface reconstruction is discussed, stressing the need for ab-initio modelling of the Au/Ru(0001) system.

1. *Seitsonen A. P.* Electronic structure of reconstructed Au(111) studied with density functional theory // Surface Science.-2016.-**643.-**P. 150-155.
2. *Repain V., Berroir J. M., Rousset S., Lecoeur J.* Interaction between steps and reconstruction on Au(111) // Europhysics Letters.-1999.-**47**, N 4.-P. 435-441.