Nanotemplate Creation and Self-assembly on the (111) Surface of Gold

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The subject of my Dissertation is self-assembly on functionalized Au(111) surface. Self-assembly on strained metallic interfaces is an attractive option for growing highly ordered multi-functional nanopatterns. I build an STM scanner and performed a series of studies in UHV to investigate the processes of ordered growth and self-assembly on Au(111).

I performed a combined AES/STM study of the formation of large networks of ordered Co islands on Au(111) and obtained the conditions for uniform bi-layer Co-teminated clusters and their thermal evolution. In another STM study I obtained novel results which reveal the particular complexity of CH_3SH self-assembly on Au(111). We observed coupling of the molecules on the FCC areas of an unperturbed Au(111) reconstruction network and the formation of two continuous ordered phases – an in-plane oriented stripe phase (β-phase) and an out-of-plane pointing, close-packed hexagonal phase (ϕ-phase). These results complement very recent theoretical investigations and contribute to an ongoing DFT calculations aimed to understand the energetics of the assembly process.

The cluster growth and the self-assembly processes are successfully combined in achieving a selective adsorption of ϕ-phase of CH_3SH on Co/Au(111) network – a prototype nanotechnology for directed self-assembly of molecular-size elements on large multifunctional templates with a nm size unit cell. The Co/Au(111) clusters thermal evolution is further established, and CH_3SH was shown to exhibit a novel, surface-mediated interaction which leads to non-dissociative dimerization and to the formation of new continuous ordered phases.