# Atomic-scale characterization of contact interfaces between thermally self-assembled Au islands and $MoS_2$ substrate surfaces

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The interaction between metallic nanoparticles and transition metal dichalcogenides (TMDs) can realize new functionalities in thriving technologies such as optoelectronics and nanoengineering. In this light, the process of self-organization during metal deposition on semiconductor surfaces is one of the attractive "bottom-up" approaches allowing a fabrication of nanostructures of desired geometrical and electrical properties.

In this contribution, we report the growth process of individual metallic nanoislands assembled on bulk $MoS_2$ and synthetically formed bi-layer $MoS_2/SO_2$ surfaces by gold deposition. Structural characterization of the as-grown Au nanoislands was performed with scanning tunneling microscopy (STM) and high resolution-scanning electron microscopy (HR-SEM) in UHV, while high-angle annular dark field scanning transmission electron microscopy (HAADF-STEM) was used to image the cross-section of the $Au/MoS_2/SiO_2$ interface.

Due to the crystallographic symmetry of the $MoS_2$ surface, the grown planar Au nanoislands are of triangular shape of 10-50 nm in lateral size and 2-8 nm in height. The actual size of the nanoislands can be controlled by the amount of deposited gold and the substrate temperature during the growth process [1]. Investigations by HAADF-STEM microscopy methods have provided detailed information on the formed interface between the epitaxial Au nanoisland and the $MoS_2$ substrate surface and the structure of the $MoS_2$ layer itself (Fig. 1). The atomic-scale resolution obtained through cross-sections of $Au/MoS_2/SiO_2$ interfaces revealed that the density of lattice sites occupied by Au atoms in the plane constituting the nanoisland/substrate interface is lower than in the Au bulk. This may be responsible for the weak interaction between the nanoislands and the substrate making this system an exemplary system for nanomanipulation [2] or to observe a geometric energy confinement in charge state-dependent sputtering by highly charged ions [3].

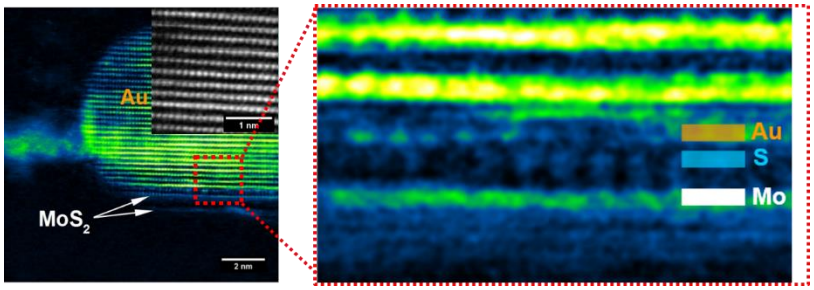


Fig. 1. (Left) Atomically resolved HAADF STEM image of a triangular Au island grown on a $MoS_2$ flake. (Right) Detailed structure of the island/substrate interface with individually resolved Au, S and Mo.

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