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Tailoring surface and thin film electronic states with curved surfaces

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Surfaces that are vicinal to high symmetry directions have frequently demonstrated their enormous potential for surface science research and applications. Vicinal surfaces exhibit distinct chemical and physical properties due to the high density of atomic steps, but they are also useful as templates for nanostructure growth, and, more generally, to transmit uniaxial and/or chiral symmetry to epitaxial layers. Moreover, vicinal planes may respond better than high-symmetry surfaces during thin-film growth, e.g., by eliminating azimuthal domains, and hence dislocation boundaries, or by enabling defect-free layer-by-layer growth through "step-flow".

A curved substrate is an obvious alternative for a fast, thorough surface analysis, i.e., for a rational optimization of physical-chemical and growth properties that are sensitive to atomic steps. Despite the clear advantage of having a tunable surface orientation at hand, the curved crystal approach has barely been used. The reason is mainly the difficulty to fabricate a customized curved surface with high precision, but also the inconveniences that a curved sample imposes, due to its inherent complexity, to surface preparation, data taking, or data analysis. However, the recent evolution of analytical surface science techniques toward laterally-resolved, scan probes at different length scale has brought the curved surface back to the scene in Surface Science.

In the past few years we have used Ag(111), Cu(111) and Au(111) curved noble metal surfaces to thoroughly explore different surface science phenomena linked to surface steps [1,2,3]. In particular, we have characterized the fundamental changes in electronic properties that metallic surface states and quantum wells of thin films exhibit in the presence of surface steps, thereby demonstrating the possibilities that this curved surface approach offers to tune all surface properties.

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