Transition metal adatoms on surfaces: Effects of local Coulomb interactions

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Achieving a realistic theory of nanoscale structures that accounts for the atomistic details of the systems and for strong electron correlations presents a long standing goal in solid state physics. Here, we discuss how the interplay of local Coulomb interactions, hybridization effects and spin-orbit coupling determines the physics of adatoms on surfaces which are the building blocks of ultimately small nanostructures. It will be shown that this interplay is effective at multiple energy scales and that it can determine the adsorption geometries of the adatoms and their stability, their electronic spectra and low energy magnetic properties like the magnetic anisotropy. This will be illustrated with the examples of rare earth and transition metal adatoms on the surfaces of normal metals, graphene and topological insulators.