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Construction of Novel 2D Atomic/molecular Crystals and Its physical Property

Control over charge and spin states at the single molecule level is crucial not only for a fundamental understanding of charge and spin interactions but also represents a prerequisite for development of molecular electronics and spintronics. While charge manipulation has been demonstrated by gas adsorption and atomic manipulation, the reversible control of a single spin of an atom or a molecule has been challenging. In this lecture, I will present a demonstration about a robust and reversible spin control of single magnetic metal-phthalocyanine molecule via attachment and detachment of a hydrogen atom, with manifestation of switching of Kondo resonance. Low-temperature atomically resolved scanning tunneling microscopy was employed. Using density functional theory calculations, the spin control mechanism was revealed, by which the reduction of spin density is driven by charge redistribution within magnetic 3d orbitals rather than a change of the total number of electrons. This process allows spin manipulation at the single molecule level, even within a close-packed molecular array, without concern of molecular spin exchange interaction. Moreover, I will talk about novel 2D atomic crystals, for example, the templates of PtSe2 and CuSe recently developed for selective self-assembly of molecules, as well as for the functionalization of the same substrate with two different species. This work opens up a new opportunity for quantum information recording and storage at the ultimate molecular limit.

References

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Figures

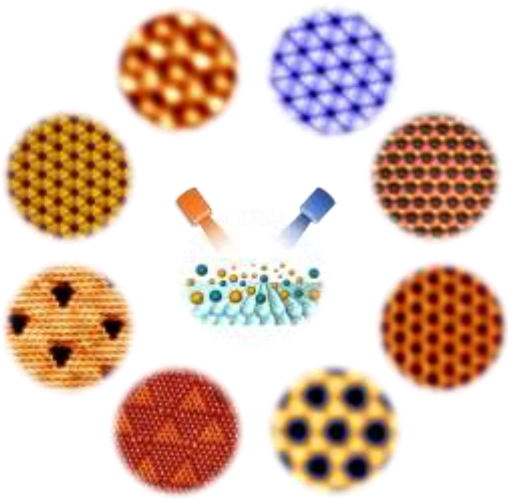

Figure 1: Different two-dimensional atomic crystals, silicene, germanene, $PtSe_2$, CuSe etc., constructed by molecular beam epitaxy.