Title: Second-layer induced island morphologies in molecular self-assembly of fullerenes on an insulating substrate

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Abstract:
Deposition of fullerenes on the CaF2(111) surface yields peculiar island morphologies that exhibit close similarities to previous findings for (100) surfaces of other ionic crystals [1,2]. By means of non-contact atomic force microscopy we find a smooth transition from branched hexagonal islands to compact, triangular islands upon increasing the temperature. By developing a kinetic growth model we unravel the microscopic mechanisms of the structure formation [3]. Based on this model, the formation of both islands types can be understood. Compared to molecular self-assembly on metal substrates, the island morphologies are qualitatively different. The key to understand the characteristic morphology of molecular islands on an insulating substrate is the process of facilitated dewetting. In particular, while a weak molecule-substrate interaction is a prerequisite for dewetting, we unravel that the island shapes are governed by the second-layer occupation rather than by the incommensurability between the structures of molecular islands and the substrate. Finally, we point out that the complex hexagonal islands originate from a transition of simple non-equilibrium structures that transform into stable islands with complicated morphology by dewetting. This work demonstrates that transient non-equilibrium structures might be deliberately employed for the formation of complex, functional structures on insulating substrates.

Figure 1: Dependence of island morphology on substrate temperature: C60 islands selfassembled on CaF2(111) imaged by non-contact atomic force microscopy.