A Rare Earth Modified Silicon Surface as a Template for Ordered Organic Growth

Milan Kubicki, Martin Franz, and Mario Dähne
Technische Universität Berlin, Institut für Festkörperphysik, Berlin, Germany

The formation of self-assembled layers of organic molecules on solid surfaces is an important subject because of their possible application in advanced (opto)electronic devices. While the formation of self-assembled layers is well established on metal surfaces, the growth on silicon surfaces, which are still the material of choice in today's semiconductor technology, is much less studied.
On pure silicon, the formation of ordered organic films is usually hindered by their high dangling bond density, so that an appropriate surface modification is required. Here we demonstrate the high potential of a rare earth modification for promoting an ordered growth.

Using scanning tunneling microscopy, we show that a terbium modified Si(111) surface enables the formation of highly ordered molecular monolayers, on the example of cobalt phthalocyanine (CoPc). CoPc belongs to the transition metal phthalocyanines being a class of organic semiconductors, which has been already employed e.g. in organic light emitting diodes, photovoltaic cells, and field-effect transistors.

Our data demonstrate that single CoPc molecules stay highly mobile at the $TbSi_2$/Si(111) surface at room temperature. By reaching a coverage of a full monolayer, a highly ordered film consisting of large domains of flat-lying CoPc molecules in an almost fourfold symmetry with different orientations is formed.

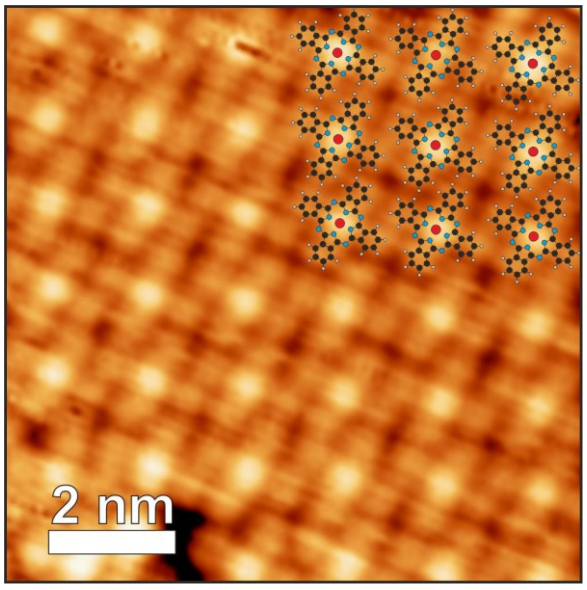

Figure 1: STM image of the ordered CoPc monolayer on a $TbSi_2$/Si(111)-surface with its structure model overlayed

[1] M. Kubicki, M. Franz, and M. Dähne, "A Rare Earth Modified Silicon Surface as a Template for Ordered Organic Growth", J. Phys. Chem. C **128**, 13347 (2024).

[+] Author for correspondence: martin.franz@physik.tu-berlin.de