Alternative <u>Super</u>conducting <u>Super</u>lattices

based on Covalent Organic Frameworks (COFs).

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Moiré materials have emerged as a novel two-dimensional platform showing unexpected exotic properties such as superconductivity. Despite the remarkable scientific progress, an important bottleneck has been the lack of a general and facile approach to the production of these materials. *SuperSuper* aims to develop a chemical bottom-up approach to prepare highly-crystalline moiré materials.

In 2022, we reported the real-time, molecular resolution STM characterization of the nucleation and growth of a pyrene-based crystalline 2D covalent organic framework (2D-COF) on graphite. Furthermore, the synthesized material was found to be twisted in consistently reproducible angles with respect to graphite[1]. Recently, we took another step forward, by reporting the exciting experimental observation of moiré superlattices on these organic materials[2].

Despite our best efforts, why the material is twisted was not yet quantitively understood. Aiming at filling this gap, we use computer modelling to study the growth of 2D-COFs at different twist angles revealing the origin of the experimental findings [3].

We will address the emergence of these synthetic twisted organic materials[1-2] as well as: 1) the physical reasons behind the twisting and 2) how this might change their properties. Overall, these results reveal, for the first time, the complex and rich behaviour of twisted 2D-COFs on graphene and should pave the way towards engineering synthetic twisted materials with moiré lattices and potential exotic properties.

References

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