Beyond the 'pre-programmed' surface-confined supramolecular self-assembly - Towards nano-optics at surface

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Abstract

A general strategy for simultaneously generating surface-based supramolecular architectures on flat sp2-hybridized carbon supports and independently exposing on demand off-plane functionality with controlled lateral order is highly desirable in view of the noncovalent functionalization of graphene.

With this aim, we recently developed the Janus tecton concept, a new Janus material [1-2]. This is a molecular three-dimensional (3D) building blocks consisting of two faces linked by a cyclophane-type pillar. One face is designed to steer 2D self-assembly onto C(sp2)-carbon-based flat surfaces, the other allowing for the desired functionality above the substrate with a well-controlled lateral order.

Here, we provide for the first time a versatile molecular platform [1] based on a library of new 3D functional nanostructures/Janus tectons able to form surface-confined supramolecular adlayers [1-3] in which it is possible to simultaneously (i) steer the 2D self-assembly on flat sp2-carbon based substrates [4] and (ii) tailor the external interface above the substrate by exposing a wide variety of small terminal chemical groups and functional moieties [1]. This approach is validated through the self-assembly study by scanning tunneling microscopy (STM) at the liquid-solid interface and molecular mechanics modelling.

The successful self-assembly on graphene, together with the possibilities to transfer the graphene monolayer onto various substrates and to transpose this approach to other 2D materials (h-BN), should considerably expend the domains of application of our functionalization strategy [1]. In this context, we recently demonstrated the first fluorescent supramolecular self-assembly on graphene with a specifically designed and synthesized three-dimensional (3D) Janus tecton.

References

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