On-surface synthesis and properties characterization of novel low-dimensional materials

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Abstract

In recent years on-surface chemical synthesis routes have succeeded in producing atomically precise nanostructures, whose synthesis cannot be achieved by standard wet chemical processes. This circumstance is due to a great extend to the usually insoluble nature of the products. In this respect, particular attention has been devoted to graphene derived carbon nanostructures such as graphene nanoribbons (GNR) and regular 2D carbon networks[1,2]. In our presentation we will review the recent developments in the field of on-surface chemical synthesis with a particular emphasis on the importance UHV-analytical and computational tools in understanding the physicochemical processes involved in the synthesis and in assessing the electronic properties of the produced nanostructures. The first part of the presentation will mainly touch the role of specific molecular precursors for the synthesis of graphene derived 2D and 1D nanostructures. We will discuss the electronic properties of these novel nanomaterials and their prospects to be used in future electronic devices.
In the second part the question, how the chemical synthesis can be guided by specific atomic surface structures will be addressed. In this context, we will turn our attention to the PdGa compound, which has been found to combine high selectivity and activity in acetylene semi-hydrogenation [3]. We will discuss the non-trivial atomic structure of the (111) and (-1-1-1) PdGa surface, which differ significantly in the local structure of the top most Pd atoms and therefore are model surfaces to study active site isolation and ensemble effects on catalyst selectivity [4]. We will then explore the possibilities of chiral selective adsorption and synthesis on these surfaces made possible by the intrinsic chiral nature of the $P2_13$ space group PdGa belongs to [5]. We show that the intrinsically chiral surfaces of PdGa can induce 99% chiral adsorption selectivity of prochiral 9-Ethynylphenantrene (9-EP) at room temperature. Similarly high chiral selectivity can be achieved in producing prochiral 9-EP trimers, which shows the potential of achieving highly asymmetric chemical synthesis on a high temperature stable metallic catalyst.

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