SS-05-1-I-W

From cluster arrays to organo-metallic spaghetti: through 2D layers to new materials

Thomas MICHELY*

II. Physikalisches Institut, University of Cologne, Germany

michely@ph2.uni-koeln.de

2D-layers, like graphene or a monolayer of hexagonal boron nitride (h-BN), enable the creation of new (hybrid)-materials, unforeseen reaction pathways or striking confinement effects. Three examples for this statement are given. (i) Room temperature deposition of carbon on a 2D-layer moire with an Ir(111) substrate results in the formation of a regular carbon cluster array with a pitch of 2.5 nm and extremely high thermal stability. The carbon cluster structure and the transformation of the clusters to graphene are discussed. (ii) The inertness of 2D-layers together with the confinement of the diffusion for the supplied reactands to two dimensions enables new reaction pathways in organo-metallic chemistry. As an example, it is shown how graphene and h-BN enable the growth of europium-cyclooctatetraene nanowires of micrometer length through supply of atomic Eu and cyclooctatetraene molecules under well-defined ultrahigh vacuum conditions. (iii) Using ion implantation and thermal processing highly pressurized precipitates of the implanted species can be created in the space between a 2D-layer and its substrate. Thereby new high temperature and high pressure reactions might come into reach. As an example for the high pressure in these precipitates, we demonstrate crystalline Xe underneath h-BN on Ir(111).

Finally, we will demonstrate how it is possible to manipulate the interaction between graphene and adsorbates. Using chemical doping via intercalation as a tool, we demonstrate that the ionic bonding of metal atoms as well as the Van der Waals binding of molecules to graphene can be tuned.

Contributions to this work by H. Ahlgren, N. Atodiresei, M.A. Arman, S. Blugel, C. Busse, V. Caciuc, F. Craes, D. F. Forster, I. Hamada, C. Herbig, F. Huttmann, W. Jolie, J. Knudsen, T. Knispel, J. Kotakoski, M. Kralj, A.V. Krasheninnikov, P, Lazic, A.J. Martinez-Galera, M. Petrovic, N. Schleheck, U.A. Schroder, S. Schumacher, P. Valerius, and T. O. Wehling are gratefully acknowledged.