Hydrogen storage with graphene functionalized by titanium

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Hydrogen is well known as a clean fuel for the future since the only waste product is water. Nevertheless, one of the main problems dealing with hydrogen as a widespread energy carrier is its storage. In this respect, graphene has recently attracted attention as a promising medium due to its small weight, chemical stability, and attractive physico-chemical properties for hydrogen adsorption. The storage capacity of graphene can be further increased by chemical functionalization of the surface with different types of metals. One of the most promising materials for this is titanium. Calculations show that each adsorbed titanium atom can bind up to 4 ~ 5 H_2 molecules, with related gravimetric density of 7.8 wt% [1]. In this work, we investigate the hydrogen storage capability of such a functionalized graphene surface.

For our studies we used monolayer graphene grown on silicon carbide. Different quantities of titanium were deposited on this surface. The characteristics of the growth process of titanium as well as the amount of coverage were determined by scanning tunneling microscopy (STM).

The Ti-covered graphene was then exposed to molecular hydrogen. Afterwards, the sample temperature was increased up to 550 ºC with a constant heating rate while measuring the mass-sensitive desorption. The thermal desorption spectra (TDS) clearly show two desorption peaks at 210 ºC and 290 ºC. Their intensity increases with increasing Ti coverage [2]. Our data demonstrate the stability of hydrogen binding at room temperature and show that the hydrogen desorbes at moderate temperatures – both in good agreement with technical requirements for hydrogen storage.

References:
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