Reversible chemical reactions on adsorbed graphene

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A robust thin film platform is a fundamental requirement for chemical sensing implying that the system must be chemically, physically and thermally stable. In addition, chemical reactions taking place on the sensors must result in detectable property changes and these reactions have to be reversible. Calculations [1] have shown that the band structure (gap size) of carbon nanotubes changes specifically upon interaction with chemical functional groups (-CH, -C-O, -C-OH and –C=O). Experimental studies [2] have proven that there is a profound conductance change when graphene oxide is reduced.

It has been demonstrated recently that a monolayer of graphite (MG or graphene) adsorbed on transition metal (TM) such as Ir and Pt is more susceptible for chemical reaction with atomic H and the adsorption process is reversible upon soft annealing, i.e. the perfect MG surface can be recovered [3]. However, not all chemical processes on such systems are perfectly reversible by thermal treatment due to the formation of strong chemical bonds between carbon atoms and an adsorbate. For example thermal breakdown of -C-O-C- and –C=O functional groups which form upon atomic oxygen adsorption on graphene can rip off carbon atoms and cause defects in the MG layer [4]. Here we report on our x-ray spectroscopic studies confirming that MG adsorbed on Ir(111) can be reduced and oxidized at room temperature repeatedly and with high degree of reversibility by atomic H and O, respectively (RT).

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