**Interfacial interaction of Pd with MoS2 and – MoS2 graphene hybrids**

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**ABSTRACT**

Hybrids of transition metal dichalcogenides (TMDs) nanoparticles on carbon-based materials have attracted considerable attention because of their remarkable physical and catalytic properties and potential applications in future electronic devices due to high electric conductivity and increase active sites. The most studied 2D TMDs are the molybdenum disulfide (MoS2), titanium disulfide (TiS2), and tungsten disulfide (WS2) [1,2]. Nowadays, it has been observed that the presence of metallic atoms on MoS2 nanosheets leads to the transformation of MoS2 phase from the semiconducting 2H- to the metallic 1T-phase, resulting in lowering the charge transfer resistance and improving the catalytic performance [3]. For example, it has been shown that functionalization of MoS2 by metallic Pd atoms offers a route to the exceptional properties of the material for catalysis of HER [4]. A drawback of the poor electric conductivity, which is known for many TMD materials, could be solved by combining the TMD nanoparticles with a conductive support such as graphite, carbon aerogels, reduced graphene oxide (rGO), carbon nanofibers, or carbon nanotubes (CNTs) [5]. The scope of the present study is to unravel the chemical interaction of Pd with MoS2 and MoS2–rGO composites. In particular, we elucidate the effect of rGO amount present in the hybrids towards the phase transition of MoS2. Pd was stepwisely deposited on MoS2 and MoS2–rGO substrates with different MoS2 and rGO hybrid’s ratio. Characterization with synchrotron radiation and X-ray photoelectron spectroscopies (XPS/SRPES) has been employed. These techniques enable non-destructive analysis of the depth profile. It was found that in the MoS2-rGO hybrids phase transition is promoted by rGO in the presence of Pd atoms, while in the case of the neat MoS2 the phase transition was limited. Phase transition takes place in the MoS2-rGO hybrids via the edges of MoS2 with the rGO. This work gives an insight into development of 2D nanomaterials functionalized with different transition metals with promising applications potentially in catalysis, optoelectronics, and sensors.

**KEYWORDS:** Molybdenum disulfide, reduced graphene oxide, phase transition, 1T-MoS2, 2H- MoS2

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