# DECORATING FEW-LAYER BLACK PHOSPHORUS WITH NICKEL NANOPARTICLES AND APPLICATION OF THE NANOHYBRID IN CATALYSIS

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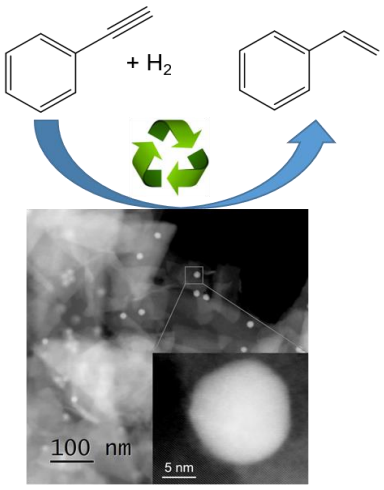
Black phosphorus (BP) has a layered structure analogue to graphite and recently[1] it was discovered that can be exfoliated down to the monolayer, following a similar procedure used for graphite. In this way, a new member of the growing family of 2D materials, named *phosphorene*, the all P-counterpart of graphene, was successfully isolated. Single and few-layer BP (2D BP) have been obtained by several techniques, among them the most used have been the micromechanical cleavage (Scotch tape method) and the liquid exfoliation.[1] In our labs, good quality phosphorene flakes were prepared by sonicating BP microcrystals in dimethylsulfoxide (DMSO) keeping an inert atmosphere and in the dark to prevent its degradation.[2] Nevertheless its ambient instability, 2D BP is attracting an enormous interest due to its direct and tunable band gap ranging from 0.3 eV (bulk) to 2.0 eV (monolayer) and a high carrier mobility (up to 6000 $cm^2V^{-1}s^{-1}$), which prompt its application towards the production of nano-electronic devices, as for instance field effect transistors (FETs). So far only an handful of reports have dealt with the chemical functionalization of 2D BP, we are currently exploring its functionalization with transition metal nanoparticles,[3] addressing in particular the study with nickel. A preformed colloidal solution of nickel nanoparticles (Ni NPs) was mixed with a suspension of 2D BP and the resulting nanohydrid Ni/2D BP was isolated. Morphological analysis carried out by electron microscopy showed the nanoparticles are well dispersed on the surface of BP (see figure). As a proof of concept, the nanohydrid Ni/2D BP was tested in the semihydrogenation of phenylacetilene to styrene (see scheme below) and it turned out to afford higher selectivity to styrene than bare Ni NPs. Additionally, the high conversion and selectivity were maintained unaltered after recycling tests, showing that 2D BP plays a key role in the stabilization of nickel nanoparticles, preventing their aggregation and deactivation.

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***References***

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