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Graphene functionalization to design metallic nanoparticles-reduced graphene hybrids with electrocatalytic properties.

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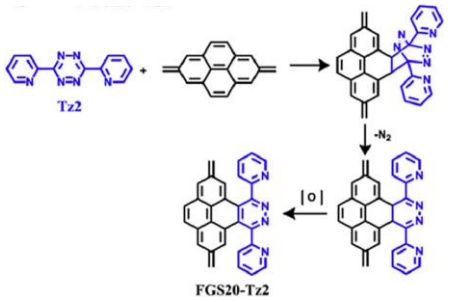
Graphene is a two-dimensional highly conjugated material with huge properties but these are difficult to reach due to the difficulty of synthesizing and manipulating it. Thus reduced graphene oxide has become a material of interest due to its large production easiness and good conductivity compared to graphene oxide, allowing its coating on an electrode. However, the lack of oxygenated functions makes its further chemical derivatization difficult.

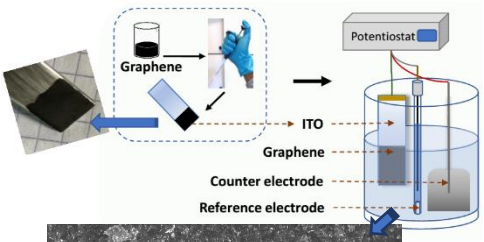
Tetrazines are small electron deficient aromatic molecules which display among others high reactivity in cycloaddition reactions through inverse demand Diels-Alder mechanism[1]. This property can be used for covalent modification of graphen to introduce organic functions like pyridines in the scheme 1 nearby.

Scheme 1

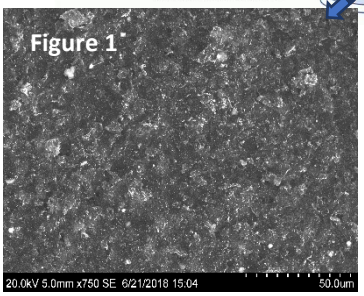


In a further step this functionalized graphene can be easily dispersed in an organic solvent and then coated on an electrode as a thin film (scheme 2).

Scheme 2



Finally electrochemical reduction of a metallic salt on this modified electrode leads to the formation of nanoparticles embedded in the graphene structure (figure 1). The final nanohybrid material can be used for electrocatalysis taking benefit of both the highly reactive nanoparticles and large surface area of graphene [2].



The role of the chemical functionalization of graphene in the nanoparticle uptake has been investigated as well as the possibility to tune the amount of chemical functions by changing the tetrazine precursor.

Références

[1] Y.Li, F. Miomandre, G. Clavier, L. Galmiche, V. Alain-Rizzo, P. Audebet, *ChemElectroChem* **4** (2017) 430

[2] Y. B. Rus, L. Galmiche, P. Audebert, A. Courty, E. Maisonhaute, and F. Miomandre, *Chem. Select.* **4** (2019) 1298.