HYBRID NANOARCHITECTURES FOR SUSTAINABLE ENERGETICS STARTING FROM 2D MATERIALS

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Graphene (G) and other 2D materials (e.g. h-BN, layered chalcogenides, carbides, and oxides) are altogether referred as Graphene Related Materials (GRMs) and they are gaining a great interest for their exceptional properties. Nowadays, the forefront of research has progressed from the simple GRMs preparation and characterization toward their use in real applications. Whereas in some devices (photonics, optoelectronics…) the goal is the most perfect GRMs assemblies with defectless interfaces, in the case of catalysts (either photo- and electro- and thermal catalysts) and sensors, the quantity and quality of the exposed surfaces and their defectivity play a leading role for the designed functionalities. In these cases, chemically-modified high surface area GRMs hybrid nanoarchitectures (organized in 2D and 3D) are the target.

The Surface Science and Catalysis group (SSCG) of the University of Padova[1] is strongly committed in exploiting the innovative properties of GRMs materials to be used as photo-, electro- and photoelectro-catalysts for the development of sustainable energetics. Among others, one route we are currently exploring is to covalently functionalize the 2D materials with electroactive molecules to develop new properties that the pristine materials do not possess in order to broaden their application in catalysis and sensing. Actually, while covalent functionalization of carbon nanostructures (graphene, nanotubes, etc) is much developed,[2] a similar approach for other 2D materials is still at its infancy.[3] In this lecture the most significant outcomes obtained in the SSCG will be outlined discussing recent examples of electrocatalysts for the Oxygen Reduction Reaction (ORR), Hydrogen Evolution Reaction (HER) and Carbon Dioxide Reduction Reaction (CRR).

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[1] People of the SSCG currently involved in the present topic are: Stefano Agnoli, Laura Calvillo, Matias Blanco, Dario Mosconi.

[2] (a) V. Georgakilas, M. Otyepka, A. B. Bourlinos, V. Chandra, N. Kim, K. C. Kemp, P. Hobza, R. Zboril and K.S. Kim, Chem. Rev., 2012, 112 (11), pp 6156–6214; (b) G. Bottari, G. de la Torre, D. M. Guldi, and T. Torres, Chem. Rev. 2010, 110, 6768–6816.

[3] S. Presolski and M. Pumera, Materials Today , 19, 2016, 3