Cristina Freire

REQUIMTE/LAQV, Departamento de Química e Bioquímica, FCUP, Rua Campo Alegre, 4169-007 Porto, Portugal

acfreire@fc.up.pt

Graphene nanocomposites in chemical, energy related electrocatalysis and sensing

Graphene materials, including pristine graphene, oxidized graphene and heteroatom doped graphene, are revolutionizing the way high performance devices are designed and fabricated, particularly in the areas of sustainable energy and environmental technologies.[1,2] From environmental remediation and sensing to energy conversions and storage, there are numerous effective cases of graphene-based materials applications.[3] Graphene materials are typically coupled with other active materials as a nanocomposite. With their outstanding properties (high surface to-bulk ratio, efficient heat transfers and electron conduction), the interface with graphene benefits the bare materials by actually emphasizing their properties.

To achieve this, the strategy of surface functionalization of graphene with inorganic materials (e.g., metal nanoparticles, oxides, semiconductors), holds the key to enabling the fabrication of high performance nanocomposites. The resultant nanoarchitectures should yield the highest achievable properties and should be unique to the specific applications.

This talk provides a bottom-up approach encompassing the design of graphene-based nanocomposites and their selected applications in high performance systems relevant to chemical catalysyis, energy related electrochemical reactions and electro-sensing.

Heteroatom-doped graphene was studied in the selective reduction of nitro- into amine-arenes, with high catalytic activity and stability/reusability. Furthermore, several graphene nanocomposites with metals oxides: mixed valence cobalt/manganese oxide, phosphomolybdates and phosphotungstates have been successfully applied in energy-related electrochemical reactions involving hydrogen and oxygen evolution reactions (HER and OER, respectively), as well as oxygen reduction. The same type of graphene nanocomposites was used as electrochemical nanosensors for biologically relevant molecules such as ascorbic acid, dopamine and uric acid.

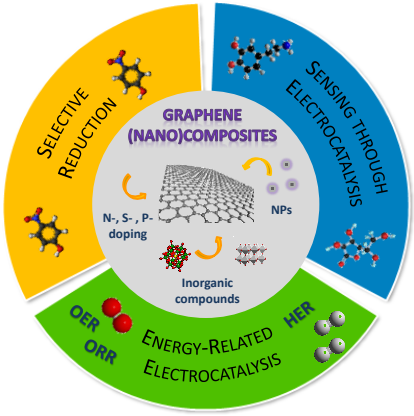

Figure 1: Graphene-based (nano)composites and their applications in selective chemical catalysis, electro-sensing and energy-related reactions.

References

[1] V. Singh, D. Joung, L. Zhai, S. Das, S. I. Khondaker, S. Seal, Progress in Materials Science 56 (2011) 1178.

[2] Y. Sun, Q. Wu, G. Shi, Energy Environ. Sci. 4 (2011) 1113.

[3] A. Ambrosi, C. K. Chua, A. Bonanni, M. Pumera, Chem. Rev. 114 (2014) 7150.

Acknowledgements

The work was funded by Fundação para a Ciência e a Tecnologia (FCT)/MEC under FEDER under Program PT2020, projects UID/QUI/50006/2013-POCI/01/0145/FEDER/007265, UniRCell", POCI-01-0145-FEDER-016422 and Program FCT – UT Austin, project ref UTAP-ICDT/CTM-NAN/0025/2014).