Carbon-based nanostructures in hybrid films with controlled porosity

25 Gennaio 2019, ore 12:00, aula B, DIFC, Via Archirafi 36.

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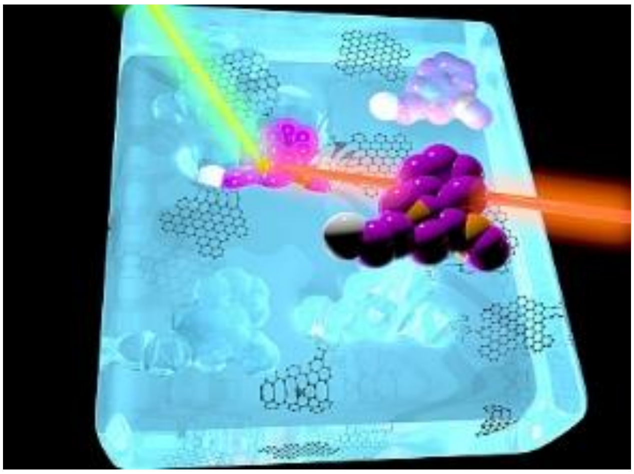
One of the most critical technological improvement in the use of exfoliated graphene (EG) and carbon-dots (CDs) is the incorporation into functional matrixes [1]. The sol−gel chemistry in combination with a templating approach based on self-assembly offers a powerful tool for the embedding of these functional nanostructures into thin porous films made by organic−inorganic hybrid or functional oxides.

The direct addition of graphene colloidal solution into highly acidic sols, for instance, is an effective method to insert graphene into highly ordered siliceous and non-siliceous hybrid organic-inorganic films. This chemical approach can be applied to the fabrication of nanocomposite films with an organized mesoporous structure, such as nano-crystalline mesoporous titania containing physically exfoliated graphene with enhanced Raman Scattering. This effect, called Ti-GERS (Titania-induced Graphene Enhanced Raman Scattering), allows exceeding the sum of the enhancements due solely to EG and crystalline titania because of a co-operative effect between graphene and crystalline titania [2]. Selective GERS substrates can also be obtained by embedding EG in molecularly-imprinted hybrid organic-inorganic silica films, envisaging their use in the near future as versatile 3D tuneable platforms for sensing applications [3].

The CDs fluorescence in combination with a proper matrix is expected to enable the development of photoluminescent materials with new properties. The overlapping of the ZnO and CDs photoluminescence, for instance, enables photo-induced energy transfer under visible or UV light which involves dipole interactions and formation of surface defects in the inorganic oxide structure [4]. More recently we have also used CDs as a tool for modulating the defects in a ZnO matrix through chemical interactions achieving an even wider range of wavelength emissions [5]. These works can be regarded as the first steps toward the engineering at the nanoscale of complex composite systems based on the synergy between functional oxides and carbon-based nanostructures.



[1] P. Innocenzi et al. Nanoscale, 7, (2015) 12759.
[2] D. Carboni et al. J. Phys. Chem. Lett., 6, (2015) 3149.
[3] D. Carboni et al. ACS Appl. Mater Interfaces 8 (2016) 34098.
[4] K. Suzuki et al J. Phys. Chem. C, 119, (2015) 2837.
[5] K. Suzuki et al. RSC Adv., 6, (2016) 55393