Nanocomposites and nanomaterials

Fluorescent carbon nanomaterials: mechanism of fluorescence and perspectives of using for cells studies.

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Fluorescent carbon nanoparticles are broadly variable structures that include short fragments of graphene, graphene oxide and nanotubes and also the ‘carbon dots’ (C-dots). They are attractive for many applications in sensing and imaging technologies substituting traditional luminophores owing to their simple and cheap synthesis and stability in aqueous medium, high photostability, the absence of toxicity and multiple possibilities for their chemical modifications. At present the physical basis for fluorescence emission from these carbon nanoscale materials is unclear with numerous fundamental questions as yet unresolved. In our work, detailed study of fluorescence intensity, lifetime and time-resolved anisotropy as a function of excitation and emission wavelengths was performed for three types of C-dots with “violet”, “blue” and “green” emissions (405nm, 450nm, 530nm respectively) On the mechanism of fluorescence, we can make the following conclusions (1,2):

- They are exposed to the solvent and can be easily quenched by diffusional quencher.
- They display spectral distribution and distribution of emission decays in a rather limited range.
- They display anisotropy of fluorescence emission and sub-nanosecond anisotropy decay that suggests their limited rotation within the particle.
- They emit individually and do not exchange energies via FRET mechanism.

We demonstrate that contrary to views of many scientists, the C-dots are not ‘quantum dots’ and even not the ‘dots’, since they are far from being zero-dimension emitters, and their fluorescence response is not collective. Also the experiments were carried out investigating the possibility of incorporating them into the cell membrane and penetration into the cell, without causing toxic effects. The result is promising suggesting their use for cell diagnostics.

1.Demchenko AP (2013) Nanoparticles and nanocomposites for fluorescence sensing and imaging. Methods and Applications in Fluorescence 1:022001

2.Demchenko AP, Dekaliuk MO (2013) Novel fluorescent carbonic nanomaterials for sensing and imaging Methods Appl. Fluoresc. 1:042001 doi:10.1088/2050-6120/1/4/042001