

DEVELOPMENT OF A BIOSENSING SYSTEM FOR TACRINE BASED ON NITROGEN-DOPED GRAPHENE QUANTUM DOTS AND ACETYLCHOLINESTERASE

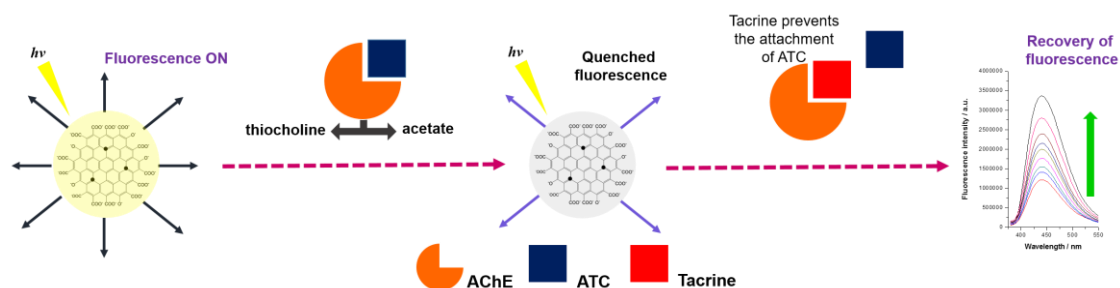
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Carbon based nanoparticles (CNPs) have been widely used in the Analytical Chemistry field, resulting to be extremely useful tools in all the stages involved in the analytical procedure. In this context, CNPs have allowed us to develop new analytical methodologies and improving other well-established analytical processes. Recently, graphene quantum dots (GQDs), have attracted much attention in optical (bio)sensing applications thanks to their fluorescence activity, robust chemical inertness, excellent photostability, high biocompatibility, tunable fluorescence emission, high solubility and ease of synthesis by using a wide range of methodologies and different carbon sources. In order to improve their reactivity and fluorescence quantum yield, the structures of GQDs have been modified by incorporating other atoms in the hexagonal carbon honeycomb lattice such as nitrogen, sulfur, and both of them.

Recent advances in sensing techniques have revealed the potential use of biomolecules as recognition elements, such as enzymes, antibodies and aptamers. Although the development of sensors by integration of these biomolecules with nanomaterials as transducing elements is a challenging issue, their conjunction might lead to better results of sensitivity and selectivity in the sensing devices.

This communication presents a novel fluorescent sensor based on the combination of nitrogen-doped GQDs (N-GQDs) and acetylcholinesterase (AChE) for the determination of tacrine, a drug currently used to treat patients with Alzheimer's disease that acts as a cholinesterase inhibitor. The proposed methodology is a simple and very sensitive sensing approach involving the use of N-GQDs as fluorescent probes and an AChE-based system as a biorecognition element for the analysis of tacrine. The principle of the developed biosensor relies on the fact that the native fluorescence of the synthesized N-GQDs is quenched by interaction with enzymatic reaction products, and the inclusion of tacrine in assay solution results in the gradual recovery of the original fluorescence in an inhibitor concentration-dependent manner. While N-GQD fluorescence was not directly affected by tacrine, the inclusion of an AChE based-enzymatic system allowed for its determination with a detection limit (S/N = 3) of 1.22 μM . This biosensor was demonstrated to be simple, rapid and reproducible (%RSD 4.87, n = 7) for analysis of tacrine in aqueous solutions.¹



¹ Benítez-Martínez, S.; Caballero-Díaz, E.; Valcárcel, M. *Analyst*, **2016**, *141*, 2688.