Maleimide-activated Carbon Nanoonion modified glassy carbon electrodes for electrochemical DNA detection

Joanne P. Bartolome[1] and Alex Fragoso[1*]

[1] Nanobiotechnology & Bioanalysis Group, Departament d'Enginyeria Química, Universitat Rovira i Virgili, Avinguda Països Catalans 26, 43007 Tarragona, Spain
joanne.pinera@urv.cat, alex.fragoso@urv.cat

Abstract

Carbon nanoonions (CNOs) are the least studied allotropes of carbon but are equally important as carbon nanotubes, graphenes and fullerenes. CNO is a multilayered fullerene concentrically arranged one inside the other and typically their size average ranges from 5nm to 50nm in diameter [1]. Similar to other carbon nanomaterials, CNOs are generally insoluble in organic and inorganic solvents thus the physical and chemical properties have not yet been well explored for many years. To improve their dispersability, CNOs were chemically functionalized [2] or incorporated in polymer composites [3] and matrices [4] to exploit their electromagnetic properties and capacitive behavior. CNOs have also been incorporated in microsupercapacitors [5] exploiting their fast charging and discharging rates and as additive in lubricant due to their tribological structure [6]. CNOs are electrically conductive and possess a much larger surface area than single-walled carbon nanotubes (SWCNTs) and are thus potential candidates for the development of miniaturized fuel cells and biosensors [7].

In this work, we have been used pristine CNOs to modify the surface of glassy carbon electrode (GCE) activated with electrografted diazonium salts bearing phenylmaleimide groups. The unmodified CNOs were purified with hydrogen peroxide, dispersed in DMF by tip sonication and characterized by TEM. Subsequently, the solution has been drop-casted into the surface of GCE and characterized by AFM. The modified surface was electrografted with N-(4-aminophenyl)maleimide diazonium salt and used to immobilize 6-(ferrocenyl)-hexanethiol and thiolated DNA probes. The modified surfaces were characterized by cyclic voltammetry in terms of surface coverage and the results were compared with GCE modified only with diazonium salt. The presence of CNO provoked a significant enhancement of current intensity, higher surface coverage area and a decrease in detection limits.

References

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Figures

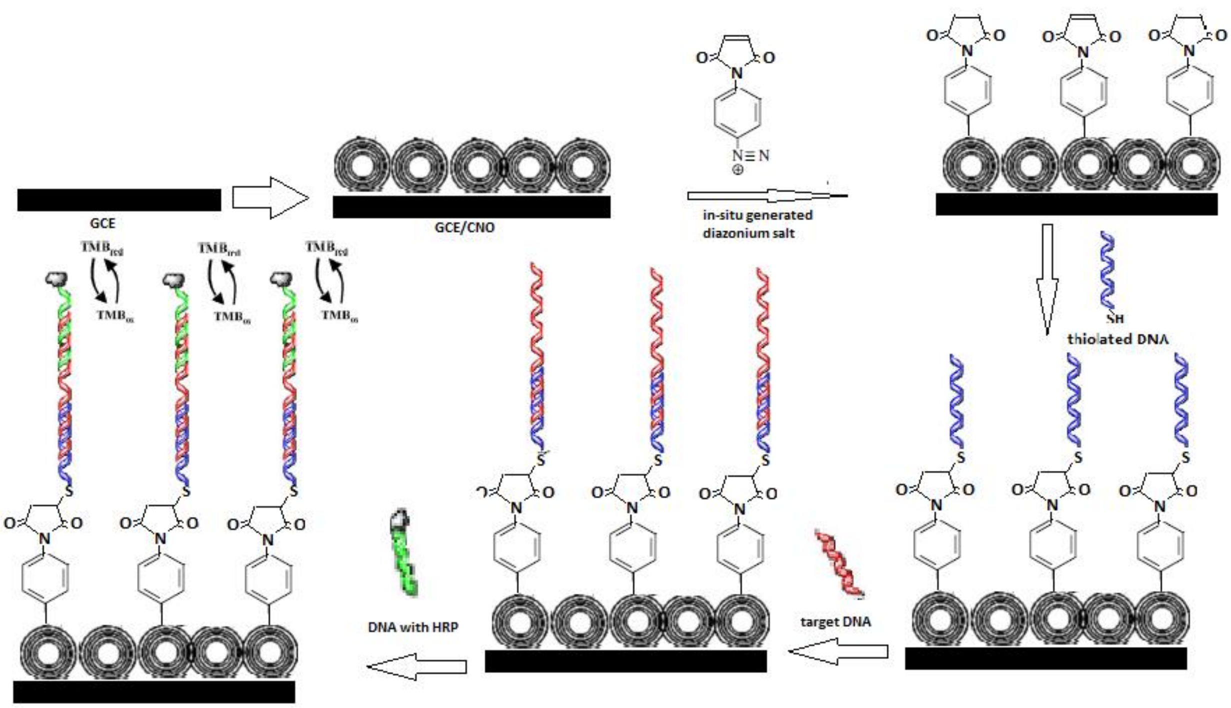

Figure 1: Glassy carbon electrode (GCE) surface modification with carbon nanoonions followed by electrochemical grafting of N-(4-aminophenyl)maleimide for DNA detection using a sandwich assay.

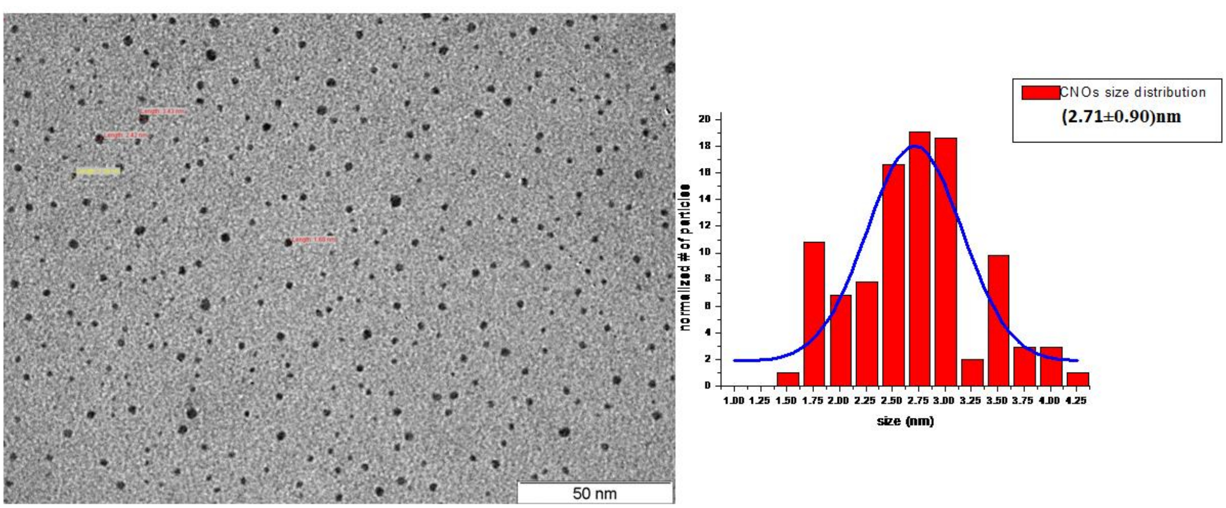

Figure 2: TEM image and size distribution chart of purified CNOs

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