Functionalization of Single-Walled Carbon Nanohorns for Biosensor Applications

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Single Walled Nanohorns (SWNHs) are a class of carbon nanomaterials derived from Single Walled Nanotubes (SWNTs), which consist of tubes, closed by a cone at one extremity, of about 2-5 nm diameter and 30 to 50 nm long. They can associate to each other to form round-shaped aggregates of about 100 nm of diameter, depending on the synthetic process and conditions (Figure 1) [1]. SWNHs are good candidates for usage in fuel cell electrodes because of their high surface area and electrical conductivity [2].

In this work, SWNHs are used as promising electrocatalytic supports for a direct methanol fuel cell (DMFC) that shall function as an innovative and autonomous biosensor for early detection of prostate cancer. In this approach, a biommimetic bioreceptor element is hosted synergistically into a DMFC, in order to provide a simple and electrically independent biosensor. Surface modified SWNHs are used herein as suitable electrocatalytic supports for anchoring later a molecular imprinting polymer (MIP) for detection of a prostate cancer biomarker.

SWNHs are synthesized by using an electric arc discharge in air [3]. Solubilization and/or dispersion of SWNHs in water are necessary to enhance their compatibility with other materials and facilitate their manipulation. For this purpose, SWNHs are oxidized using two different approaches: (1) treatment with O_2 (g) at high temperatures; (2) treatment with an oxyacid (HNO_3), in aqueous medium. The metal catalysts Pt and Ru are then deposited onto the surface of the oxidized SWNHs, by a chemical reduction method. The original and modified SWNHs are characterized by FTIR-ATR, Raman Spectroscopy, TG analysis and TEM. The characterization techniques evidenced the occurrence of chemical modifications on the surface of the SWNHs without altering their intrinsic structure. The effects of SWNH oxidation on MIP grafting are also addressed.

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References

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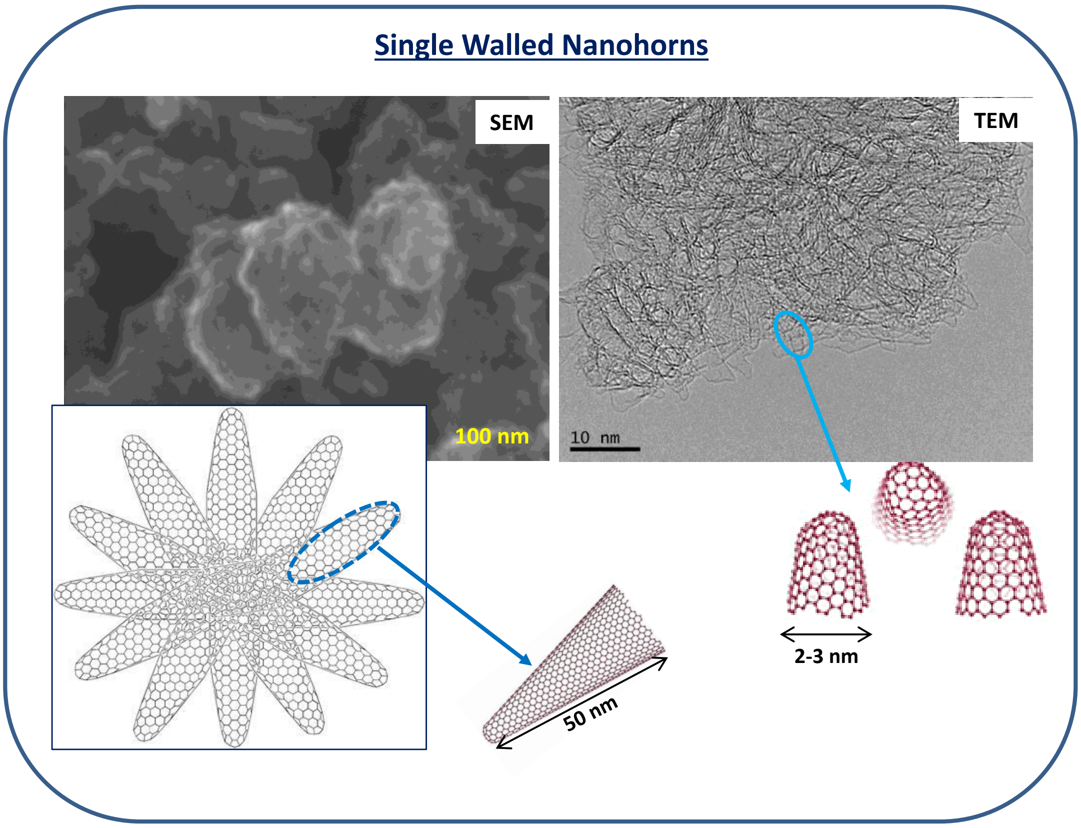

Figure 1 – Structure of non-modified SWNHs and respective SEM and TEM images.