

Nanocharacterization of Carbon Nanotube Biosensors for Point-of-Care Diagnostics

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High resolution scanning electron microscopy (SEM) and scanning transmission electron microscopy (STEM) have been used to characterize the morphology of carbon nanotube (CNT) films cast onto screen printed electrode biosensors. These biosensors have been shown to be useful in a variety of clinically relevant assays, including an ultra-sensitive immunoassay for Troponin I and an enzyme assay for Creatinine.

The performance of a sensor is determined by the nature of the CNT film and the attached biological receptor [i.e., antibody or enzyme]. In this study, the bulk CNT material was analyzed in a Hitachi HD-2300 dedicated STEM in order to characterize the bundles of CNTs in the starting material (Fig. 1). The printed electrode biosensors were analyzed using an FEI Sirion 400 field emission SEM (FESEM) and a Hitachi S-5500 FESEM (Fig. 2 and 3). Scanning electron microscopy can provide an understanding of the morphology and distribution of the CNTs on the printed electrode, as well as information on the receptors used in the biosensors.

Gold nanoparticles have been attached to CNT bound receptors to aid in visualization. Using backscattered electron (BSE) imaging, the gold nanoparticles can be observed. The BSE images of the gold nanoparticles identify the location of the receptors, but also provide information on the location, density, and clustering characteristics of the receptors (Fig. 3).

This presentation will expand on the characterization of biosensor and describe a multiplexed point-of-care device that uses a plurality of CNT sensors in a flow channel for the analysis of whole blood from a finger stick.

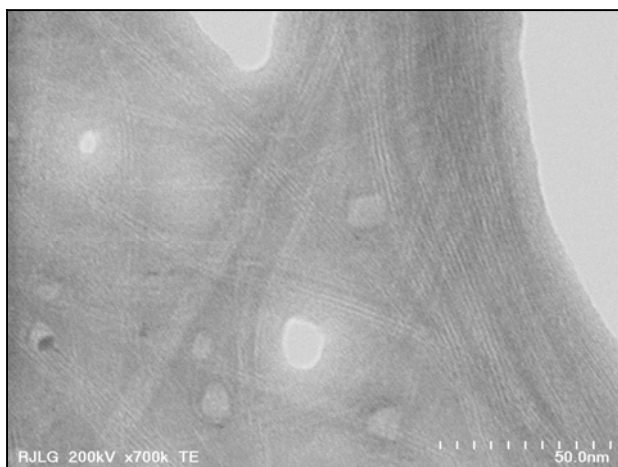


Fig. 1: Bright-field STEM image of the bulk CNT material collected on the HD-2300 dedicated STEM.

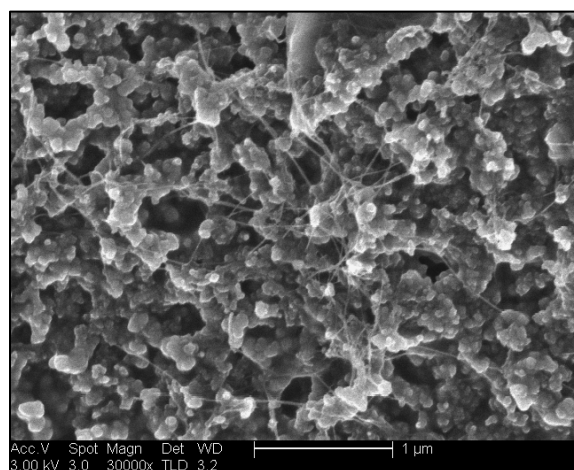


Fig. 2: A secondary electron image collected on the FEI Sirion FESEM showing the distribution of the CNTs on the printed electrode.

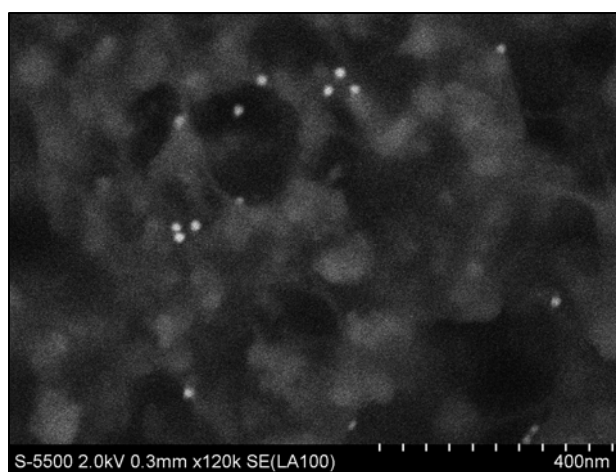


Fig. 3: A backscattered electron image collected on the Hitachi S-5500 FESEM showing the gold nanoparticles distributed on the CNTs.