Label-free Detection of Cardiac Troponin-I using Carbon Nanofiber based Nanoelectrode Arrays

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A sensor platform based on vertically aligned carbon nanofibers (CNFs) has been developed. Their inherent nanometer scale, high conductivity, wide potential window, good biocompatibility and well-defined surface chemistry make them ideal candidates as biosensor electrodes. A carbon nanofiber (CNF) multiplexed array has been fabricated with 9 sensing pads, each containing 40,000 carbon nanofibers as nanoelectrodes. Here, we report the use of vertically aligned CNF nanoelectrodes for the detection of cardiac Troponin-I for the early diagnosis of myocardial infarction. Antibody, anti-troponin, probe immobilization and subsequent binding to human cardiac troponin-I were characterized using electrochemical impedance spectroscopy and cyclic voltammetry techniques. Each step of the modification process resulted in changes in electrical capacitance or resistance to charge transfer due to the changes at the electrode surface upon antibody immobilization and binding to the specific antigen. This sensor demonstrates high sensitivity, down to 0.2 ng/mL, and good selectivity making this platform a good candidate for early stage diagnosis of myocardial infarction.