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# Electrochemical immunosensor based on Magnetite Nanoparticles Incorporated into Electrospun Polyacrylonitrile Nanofibers for Vitamin-D<sub>3</sub> detection

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## Abstract

In the present study, magnetite nanoparticles (Fe<sub>3</sub>O<sub>4</sub> NPs) incorporated polyacrylonitrile nanofibers (PANnFs) having diameter of 350-500 nm, were electrospun and directly collected onto indium tin oxide (ITO) coated glass substrate. X-ray diffraction pattern of Fe<sub>3</sub>O<sub>4</sub>-PANnFs confirmed the existence of Fe<sub>3</sub>O<sub>4</sub> NPs within the PANnFs. Nafion was used to make Fe<sub>3</sub>O<sub>4</sub>-PANnFs more adhesive to the ITO surface. Partial hydrolyzation of Fe<sub>3</sub>O<sub>4</sub>-PANnFs/ITO electrode was done using NaOH solution for the partial conversion of nitrile group (C≡N) into carboxyl and amine groups that was confirmed by Fourier transform infrared spectroscopy study. The hydrolyzed Fe<sub>3</sub>O<sub>4</sub>-PANnFs/ITO electrode was used as an immobilization matrix for monoclonal antibody specific to Vitamin-D<sub>3</sub> (Anti-VD) via 1-ethyl-3-(3-dimethylaminopropyl) carbodiimide and N-Hydroxysuccinimide chemistry. Bovine serum albumin was used as a blocking agent to block the non-specific sites onto Anti-VD/Fe<sub>3</sub>O<sub>4</sub>-PANnFs/ITO electrode surface. Fabricated BSA/Anti-VD/Fe<sub>3</sub>O<sub>4</sub>-PANnFs/ITO immunoelectrode showed improved biosensing parameters for Vitamin-D<sub>3</sub> detection such as sensitivity of 0.90 μA ng<sup>-1</sup> mL cm<sup>-2</sup>, limit of detection of 0.12 ng mL<sup>-1</sup> and detection range of 10 - 100 ng mL<sup>-1</sup>. The association and dissociation constants were obtained as 74.62 ng mL<sup>-1</sup>, 4.6 ng mL<sup>-1</sup>, respectively.

Keyword: Electrospinning; magnetite NPs; PAN nanofibers; Immunosensor; Vitamin-D<sub>3</sub>

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