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## Improved electrochemical performance of metal doped Zirconia nanoparticles for detection of Ochratoxin-A

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### Abstract

Here, aluminum (Al) doped Zirconia nanoparticles (ZrO<sub>2</sub> NPs) were proposed as a novel material for the fabrication of an efficient electrochemical immunosensor. X-ray diffraction (XRD) analysis and high resolution–transmission electron microscopy (HR-TEM) images visualized phase stabilization and generation of oxygen deficiency in the ZrO<sub>2</sub> NPs due to doping of Al ions (Al<sup>3+</sup>) in ZrO<sub>2</sub> lattice. On the increase in Al<sup>3+</sup> concentration, a sequential decrease in crystallite size of ZrO<sub>2</sub>NPs describes the Zener pinning effect. Further increase in Al<sup>3+</sup> concentration (beyond 11 mol%) terminated crystallinity of ZrO<sub>2</sub> NPs. The generated oxygen deficiency due to Al<sup>3+</sup> doping increased the surface charge and hydrophilicity of ZrO<sub>2</sub> NPs as observed by zeta potential and contact angle measurements, respectively. Moreover, oxygen deficiency was the main reason for the remarkable enhancement in the electrochemical behavior of Al<sup>3+</sup> doped ZrO<sub>2</sub> NPs, and maximum was observed for 7 mol% Al<sup>3+</sup> doped ZrO<sub>2</sub> NPs. Thus, 7 mol% Al<sup>3+</sup> doped ZrO<sub>2</sub> NPs based Al<sup>3+</sup>-ZrO<sub>2</sub>/ITO electrodes were fabricated via electrophoretic deposition and further functionalized with antibodies specific to Ochratoxin A (anti-OTA) and bovine serum albumin (BSA). Fabricated BSA/anti-OTA/Al<sup>3+</sup>-ZrO<sub>2</sub>/ITO immunoelectrode showed improved sensitivity of 34.07  $\mu\text{A} (\log \text{ng mL}^{-1})^{-1}$  and LOD of 0.14 ng mL<sup>-1</sup> in the detection range of 1–10 ng mL<sup>-1</sup> as compared to BSA/anti-OTA/ZrO<sub>2</sub>/ITO immunoelectrode for the detection of OTA. Moreover, recovery of OTA from the spiked sample was observed in the range of 93.3–99.2 % with maximum RSD of 4.86.

**Keywords:** Zirconia Nanoparticles, Metal doped, Electrochemical, Ochratoxin-A, Immunosensor

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