

## Nanomaterials Based Biosensing Chip for Non-Invasive Detection of Oral Cancer

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**Abstract :** Oral cancer (OC) is the sixth most death causing cancer in world which includes tumour of lips, floor of the mouth, tongue, palate, cheeks, sinuses, throat, etc. Conventionally, the techniques used for OC detection are toluidine blue staining, biopsy, liquid-based cytology, visual attachments, etc., however these are limited by their highly invasive nature, low sensitivity, time consumption, sophisticated instrument handling, sample processing and high cost. Therefore, we developed biosensing chips for non-invasive detection of OC via CYFRA-21-1 biomarker. CYFRA-21-1 (molecular weight: 40 kDa) is secreted in saliva of OC patients which is a non-invasive biological fluid with a cut-off value of 3.8 ng mL<sup>-1</sup>, above which the subjects will be suffering from oral cancer. Therefore, in first work, 3-aminopropyl triethoxy silane (APTES) functionalized zirconia (ZrO<sub>2</sub>) nanoparticles (APTES/nZrO<sub>2</sub>) were used to successfully detect CYFRA-21-1 in a linear detection range (LDR) of 2-16 ng mL<sup>-1</sup> with sensitivity of 2.2  $\mu$ A mL ng<sup>-1</sup>. Successively, APTES/nZrO<sub>2</sub>-RGO was employed to prevent agglomeration of ZrO<sub>2</sub> by providing high surface area reduced graphene oxide (RGO) support and much wider LDR (2-22 ng mL<sup>-1</sup>) was obtained with remarkable limit of detection (LOD) as 0.12 ng mL<sup>-1</sup>. Further, APTES/nY<sub>2</sub>O<sub>3</sub>/ITO platform was used for oral cancer biosensor development. The developed biosensor (BSA/anti-CYFRA-21-1/APTES/nY<sub>2</sub>O<sub>3</sub>/ITO) have wider LDR (0.01-50 ng mL<sup>-1</sup>) with remarkable limit of detection (LOD) as 0.01 ng mL<sup>-1</sup>. To improve the sensitivity of the biosensing platform, nanocomposite of yattia stabilized nanostructured zirconia-reduced graphene oxide (nYZR) based biosensor has been developed. The developed biosensing chip having ability to detect CYFRA-21-1 biomolecules in the range of 0.01-50 ng mL<sup>-1</sup>, LOD of 7.2 pg mL<sup>-1</sup> with sensitivity of 200  $\mu$ A mL ng<sup>-1</sup>. Further, the applicability of the fabricated biosensing chips were also checked through real sample (saliva) analysis of OC patients and the obtained results showed good correlation with the standard protein detection enzyme linked immunosorbent assay (ELISA) technique.

**Keywords :** non-invasive, oral cancer, nanomaterials, biosensor, biochip

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