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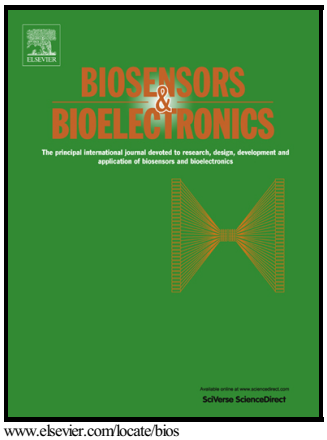

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Fluorescent magnetic bead-based mast cell biosensor for electrochemical detection of allergens in foodstuffs

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ABSTRACT

In this study, a novel electrochemical rat basophilic leukemia cell (RBL-2H3) cell sensor, based on fluorescent magnetic beads, has been developed for the detection and evaluation of different allergens in foodstuffs.Fluorescein isothiocyanate (FITC) was successfully fused inside the SiO_2 layer of SiO_2 shell-coated Fe_3O_4 nanoparticles, which wassuperior to the traditional Fe_3O_4@SiO_2@FITC modification process. The as-synthesized fluorescent magnetic beads were then encapsulated with lipidosometo form cationic magnetic fluorescent nanoparticles (CMFNPs) for mast cell magnetofection. The CMFNPs were then characterized by SEM, TEM, VSM, FTIR, and XRD analyses, and transfected into RBL-2H3 cells through a highly efficient, lipid-mediated magnetofection procedure. Magnetic glassy carbon electrode (MGCE), whichpossesses excellent reproducibility and regeneration qualities, was then employed to adsorb the CMFNP-transfected RBL-2H3 cells activated by an allergen antigen for electrochemical assay. Results show that the exposure of model antigen-dinitrophenol-bovine serum albumin (DNP-BSA) to anti-DNP IgE-sensitized mast cells induced a robust and long-lasting electrochemical impedance signal in a dose-dependent manner.Thedetection limit was identified at3.3×10^{-4} ng/mL. To demonstrate the utility of this mast cell-based biosensor for detection of real allergens in foodstuffs, Anti-Pen a1 IgE and Anti-PV IgE-activated cells were employed to quantify both shrimp allergen tropomyosin (Pen a 1) and fish allergen parvalbumin (PV). Results show high detection accuracy for these targets, with a limit of 0.03