Near East University

Innovative Point-of-Care Biosensors Targeting SMAD3 for Early Detection of Alzheimer's Disease

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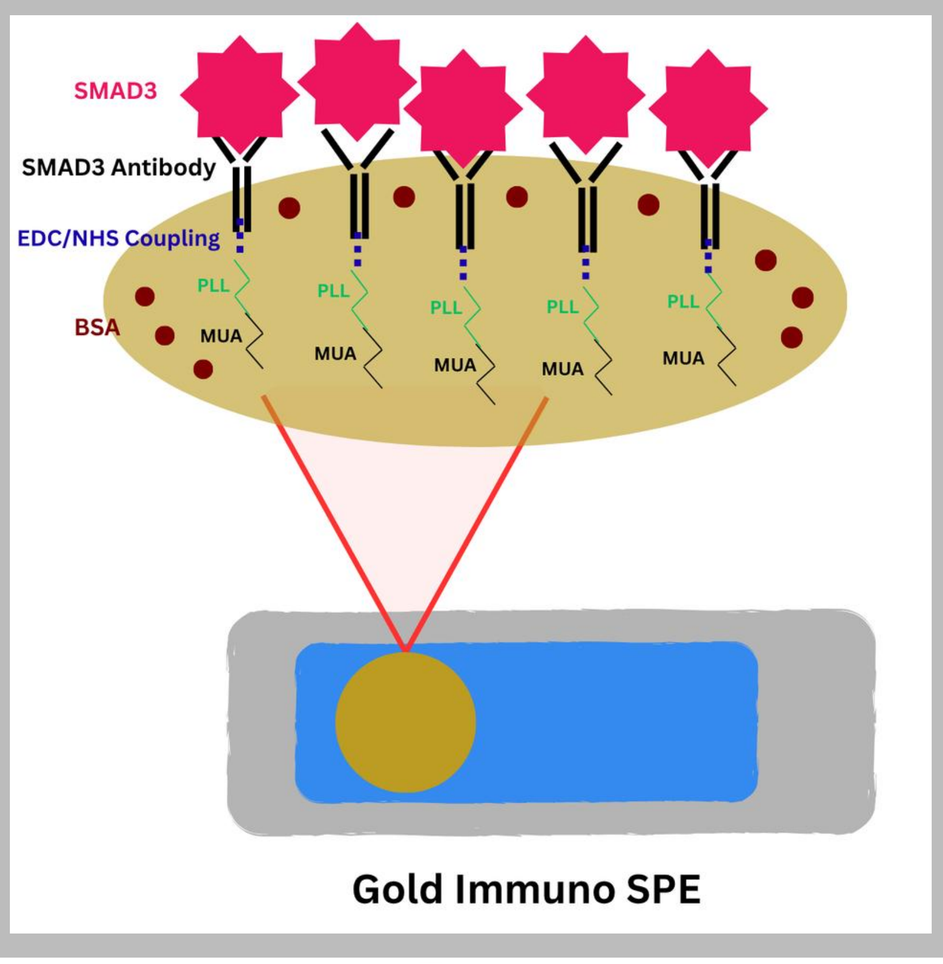
Abstract

Alzheimer's disease is a progressive neurodegenerative disorder marked by cognitive decline and chronic neuroinflammation. Current diagnostic methods, such as PET scans and ELISA, are costly or lack sensitivity. SMAD3, a signaling protein in the TGF-β pathway, plays a role in neuroinflammation. SMAD3 has been linked to amyloid-β accumulation and tau pathology. No biosensor currently exists for SMAD3 detection. This project introduces a novel and cost-effective screen-printed electrode (SPE)-based biosensor functionalized with mercaptoundecanoic acid (MUA) and poly-L-lysine (PLL) for antibody immobilization. The biosensor aims to provide early and accurate detection of SMAD3. The aim of this project is to develop point-of-care diagnostics for the early detection of Alzheimer's disease.

Methodology

I. Fabrication of SPE Biosensor

- Gold SPE surface modified with MUA and PLL.
- EDC/NHS chemistry used for covalent attachment of anti-SMAD3 antibodies.



2. Characterization

- Surface Analysis: AFM, SEM, EDX, Contact Angle measurements.
- Electrochemical techniques: Differential Pulse Voltammetry (DPV), Electrochemical Impedance Spectroscopy (EIS).

3. Validation

- Detection across varying SMAD3 concentrations.
- Selectivity studies against non-target molecules.
- Stability and reproducibility tests.
- Artificial serum samples used to simulate clinical conditions.

Results (Expected Outcomes)

- High sensitivity and specificity for SMAD3 detection.
- Low limit of detection (LOD) and quantification (LOQ).
- Stable performance with reproducibility across multiple trials.
- Portable and cost-effective biosensor design suitable for point-of-care use with scalable application.

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