Scientific report

regarding the implementation of the project "An innovative non-invasive detection system for the diagnosis of celiac disease"

(Acronym: InoCelDetect)

Financing contract 581/2022. Project code: PN-III-P2-2.1-PED-2021-4405

Period: January – December (M7-M19) 2023

According to the plan for the realization of the project in the period July 2022 - December 2022, the project team from the Politehnica University of Bucharest (UPB) - coordinator and the National Institute for Mother and Child Health "Alessandrescu-Rusescu" Bucharest (INSMC) - partner, carried out the following corresponding activities Stage 2:

Task 0 - Project management (M1-M24)

Activity 0.1 Project and partnership management (M1-M24) UPB (DC) and INSMC (PA)

Meetings were organized between partners and telephone discussions or email exchanges were held to establish the objectives of the development project, risk analysis, dissemination of results and intellectual property rights.

Activity 0.2 Management of work packages (M1-M24) UPB (DC) and INSMC (PA)

During the team meetings, their consistency with the proposed activities and deliverables and also compliance with the obligations assumed by each partner was verified.

Activity 0.3 Communication management (M1-M24) UPB (DC) and INSMC (PA)

Effective communication between partners was ensured through face-to-face meetings at the INSMC, e-mails or telephones. Communication with the national contractual authority UEFISCDI was also ensured.

Deliverables

From the performance of activities 0.1, 0.2 and 0.3, the members of the project team participated in the compilation of the scientific report and the reporting sheets (FEC, DPC, reallocation agreement) requested by UEFISCDI.

Task 1. Modification of the electrode surface with PPyNWs/GQDs (M1-M8) UPB

Activity 1.2 Surface modification with PPyNWs/GQDs (M4-M7) UPB – complete

At this stage, chronoamperometric PPy deposition was also performed at 0.8 V.

Graphene quantum dots (QDS) were obtained from citric acid - citric QDS. Other types of graphene quantum dots were also synthesized: QDS urea (QDS doped with nitrogen QDS urea), folic acid (QDS folic) and cysteine (doped with nitrogen and S, QDS cysteine).

Urea QDS were characterized by SEM, TEM, UV, FTIR and fluorescence.

The GC/PPy TsOH/QDS urea electrode had the best signal.

Activity 1.3 Characterization and optimization of the hybrid electrodes obtained (M6-M9) UPB - complete

The morphology of the GC/PPyTsOH and GC/PPyTsOH/urea QDS electrode was observed using SEM.

Surface roughness was observed using atomic force microscopy (AFM).

The wettability [contract angle (CA)] was measured by the sessile drop method with three liquids and the surface energy was calculated.

The transmission spectrum was recorded using Fourier transform infrared (FT-IR) spectroscopy.

The electrochemical behavior was investigated using electrochemical impedance spectroscopy (EIS), Mott-Schottky, Tafel and cyclic voltammetry (CV).

With the help of UV, the spectra of the two samples were recorded and then the band gap potentials and the Urbach energy were determined.

Task 2 – Antigen immobilization on hybrid conductive polymer films (M9-M13)

Activity 2.1 Preparation of antigen immobilization detection systems (M9-M11) UPB (DC, PS, BGO, CA) - complete

The 4th generation PAMAM dendrimer was bound on the electrode surface.

Activity 2.2 Morphological and electrochemical characterization of the obtained detection system (M11-M13) UPB (DC, PC, PS, BGO, CA) - complete

The morphological and topographic features of PPyNWs/GQDs/PAMAM and PPyNWs/GQDs/PAMAM/TTG will be observed with SEM, AFM and FT-IR.

The obtained electrodes were also characterized by means of XPS.

Contact angle analysis was performed to give an indication of the hydrophilic or hydrophobic nature of these modified electrodes.

The obtained detection systems were electrochemically characterized in phosphate buffer solution (PBS) containing the redox couple Fe2+/Fe3+ by means of EIS, Mott-Schottky, Tafel, CV.

Task 3. Preparation of samples for system validation (M1-M16) INSMC

Activity 3.1 Defining the inclusion criteria of samples that will be used for system validation (M1-M16) INSMC – complete

Activity 3.2 Characterization of selected biobank samples (M1-M16) INSMC – complete

Task4 – Applicability evaluation of the obtained system for the serological detection of anti-transglutaminase antibodies from patients' samples (M14-M24)

Activity 4.1 Optimizing the experimental parameters for the quantification of anti-tTG antibodies (M13-16) UPB (DC, BGO, CA) – complete

The electrochemical technique used for signal acquisition was differential pulse voltammetry (DPV).

Activity 4.2 Specific tests for a sensor and calibration curve (M15-M18) UPB (DC, BGO, CA) – partial 2 months

A calibration curve was obtained using different concentrations of antibody