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Cyclic and differential pulse voltammetric measurements on fibrils formation of alpha synuclein in Parkinson's disease by a gold interdigitated tetraelectrodes

Abstract

Parkinson's disease is a neurodegenerative disorder characterized by the aggregation and deposition of alpha-synuclein protein, which are pathological hallmarks. To understand the fibril formation of alpha-synuclein in Parkinson's disease, this study uses cyclic and differential pulse voltammetric measurements. These measurements analyze the electrochemical properties and behavior of alpha-synuclein during its fibril formation process. By applying a potential sweep or pulse to the alpha-synuclein sample, it is possible to gain insights into its redox activity and structural changes during fibril formation. This could lead to the development of therapeutic strategies to prevent or disrupt this pathological event in Parkinson's disease. To detect Parkinson's disease, a 15 nm sized gold conjugated antibody was used as the probe and seeded on gold interdigitated tetraelectrodes (AuIDTE). Alpha synuclein variations (fibriled and non-fibriled) were detected using phosphate-buffer saline and glycine buffer based on cyclic voltammetry and differential pulse voltammetry techniques. Discriminated by Tau protein measurement that was employed as a control. The linear regression for detecting alpha synuclein aggregation using differential pulse voltammetry was R^2 = 0.9987 [y = 9E-06x - 4E-07], with a limit of detection of 10 aM, on a linear range of 1 aM-1 pM. Cyclic voltammetry determined the limit of detection of aggregated alpha synuclein to be 100 aM, with a linear relationship of R^2 = 0.9939 [y = 7E-06x - 2E-06]. The sensor has excellent analytical performance in terms of detection limit, sensitivity, selectivity, repeatability, and stability.

Keywords

Amyloid fibrils; Biomarker; Nanobiosensor; Nanomaterial; Parkinson's disease