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Development of an electrochemical biosensor for Machado-Joseph disease biomarker detection

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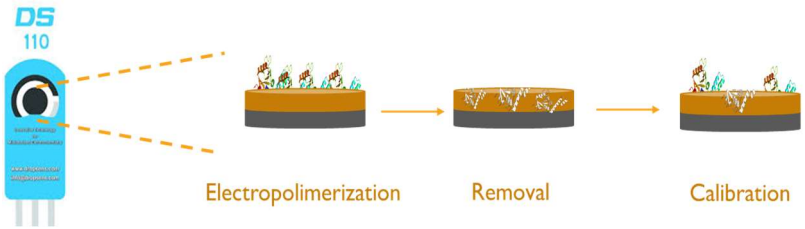
Machado-Joseph disease (MJD) or spinocerebellar ataxia type 3 (SCA3) is a neurodegenerative disease with an autosomal dominant inheritance pattern. Nowadays, it is the most common form of spinocerebellar ataxia and an incurable disorder, which leads to death[1].

MJD is caused by the expansion of CAG trinucleotide repeat in the coding region of the gene ATXN3 and the aggregation of the resulting product. This polyQ expansion is thought to be the key of the disease, in which the length of this polyQ extension is linked to earlier and more severe symptons[2]. This mutant protein disturbs the normal neuronal function and leads to its degeneration, with subsequent formation of neuronal intranuclear inclusions. Although there is no treatment available, a more accurate diagnosis of MJD may lead to relieved symptoms[2]. Research activities targeting such possibility include the identification of biomarkers in several biological fluids that may turn out an important means to early diagnosis or even potential therapy biomarkers within future[3,4].

Thus, this work develops novel and low cost electrochemical (bio)sensing devices to detect ataxin 3 protein (atx3), comprising a molecularly-imprinted polymer as biorecognition element. This element was obtained as an electrochemically synthesised molecularly-imprinted polymer (MIP) that was tyramine-based. The tyramine monomer was mixed with atx3, on a carbon screen-printed electrode (SPE), and assembled as shown in scheme 1. The surface modification and the ability of the material to rebind the atx 3 oligomers was measured by electrochemical techniques, namely electrochemical impedance spectroscopy, square wave voltammetry and cyclic voltammetry.

The biorecognition element was successful constructed on the SPE. The control of the surface modification was evaluated electrochemically. Further tests are progressing to obtain a specific and sensitive biosensor for the detection of the target biomolecule.



Scheme 2: Schematic representation of the construction steps of the biosensor, from electropolymerization with tyramine in conjunction with the biomarker (atx3 oligomers), to rebinding of atx3 that leads to the calibration, made with increasing concentrations atx3.

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