Società Chimica Italiana
Divisione di Elettrochimica

GIORNATE dell'ELETTROCHIMICA ITALIANA ORVIETO 2022

Palazzo del Capitano del Popolo
September 11th - 15th, 2022

Collection of abstracts

Development of electrochemical sensors for the determination of the different forms of iron as possible biomarkers for the early diagnosis of neurodegenerative diseases.

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Several studies in the literature concern the search for correlations between the forms of Fe present in the serum of patients suffering from forms of hepatitis and cirrhosis of the liver and the progress of the disease. Recently, the concentration of this element in cerebrospinal fluid (CSF) and serum seems to be an interesting biomarker for the early diagnosis of Alzheimer's disease[1].

The ambitious aim of this study is to develop an electrochemical sensor for the simultaneous determination of Fe^{2+} and Fe^{3+} and a procedure that allows a quick distinction between free Fe and complexed Fe. We focused our attention on electrodes based on glassy carbon (GCE) or carbon paste (CPE), easily modifiable materials. The CPEs will be modified with the same modifying agents used for the GCEs; furthermore, suitable ionic liquids and / or charge transfer crystals will be inserted inside the paste, in order to maximize the sensitivity of the method, reducing as much as possible the required sample volume.

During the first phase, the species of interest were determined in synthetic solutions, so as to be able to optimize the procedure for modifying the electrodes (concentration of the modifier, contact times, etc.) and the instrumental parameters used during the phase of analysis (method and speed of potential scanning, presence of ligands in solution, supporting electrolyte, applied potentials).

The voltametric results were compared with those obtained by spectrophotometric methods for the analytical determination of Fe in different oxidation states following complexation with ferrozine and deferoxamine. Furthermore, nanostructures able to chelate iron were designed and evaluated.

In order to characterize the structure and morphology of the modified electrodes, scanning electron microscopy (SEM and FESEM) and transmission (TEM and TEM high resolution) measurements were performed, combined with EDS analyses.

The availability of a sensor for the detection and quantification of the different forms of iron in biological liquids would allow an increase in the number of possible controls, at very low costs and in any hospital since the equipment is portable. Furthermore, it will be possible to fill the gaps concerning the distribution and transfer mechanisms of the different forms of iron within the body and their involvement in neurodegenerative diseases.

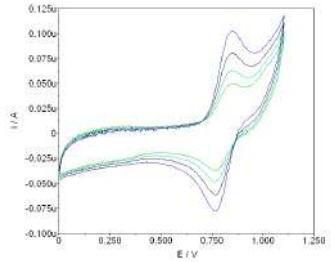

Figure 1. Voltammograms obtained by ciclic voltammetry for nafion modified-glassy carbon electrode for couple Fe^{2+}/Fe^{3+} at different concentration

References

[1] SohaAhmadi et al., *Electrochimica Acta* **2017** 236, 384