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Ascorbic acid electro-oxidation by modified electrodes: Ppy and Ppy/Ni(OH)$_2$ films

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Abstract – Ppy and Ppy/Ni(OH)$_2$ films were synthesized on glassy carbon and FTO electrodes applying a controlled potential (0.70 V). Essays by FTIR confirmed the presence of the film through the typical absorption bands. The presence of Ni(OH)$_2$ in polymer matrix is verified by XRD, using the characteristic of diffraction peaks and VC through the oxidation peak at approximately 0.62 V, corresponding to the redox couple Ni^{2+}/Ni^{3+}.VC and chronoamperometry techniques showed that Ppy/Ni(OH)$_2$ are more sensitive to ascorbic acid than Ppy, 133.4 e 83.8 mA L mol^{-1} cm^{-2} respectively.

In recent years, the development of chemical, electrochemical and biosensors have increased significantly regarding the fast response, stability and sensitivity. Ascorbic acid is a molecule with high interest in chemical and biological process, once it plays an important role in human health and is used in treatment of colds and flu, mental illness, infertility and cancer, and act as electron donor in the hydroxylation of proline, leading to formation of collagen [1]. The quantification of this species by traditional methods requires a reasonable time of analysis and present some disadvantages such as low reproducibility, sensitivity and selectivity. In this sense, there is the need for developing new routes to determine fast and accurately some substances. Electrochemical sensors are presented as excellent devices for measurement of various molecules of biological interest, including ascorbic acid, because of its practicality, reproducibility, low cost and especially high sensitivity and selectivity [2]. Several materials such as conducting polymer, metals, alloys, oxide and mixed oxides have been used as electrodes for the electrocatalytic oxidation of organic molecules for sensor application [3, 4]. Polypyrrole is the most widely used conducting polymer to the construction of sensors and biosensors, once their conductivity and electroactivity do not strongly depend on pH of the electrolytic. In this context, this study investigated is the use of thin films of pure polypyrrole (ppy) and films of polypyrrole doped with nickel (ppy/Ni(OH)$_2$) as alternative materials for quantification of ascorbic acid. Ppy and Ppy/Ni(OH)$_2$ films were synthesized by cathodic electrodeposition on glassy carbon and FTO (tin oxide doped with fluorine) electrodes, applying a controlled potential of 0.7 V *vs* Ag/AgCl for different times. Regardind the electrodeposition of doped film were used 30 mL of nickel nitrate and distilled pyrrole solution, both in the same concentration (3.10^{-2} mol L^{-1}) and for the electrodeposition of the pure film were used 30 mL of sodium nitrate and distille pyrrole, both 3.10^{-2} mol L^{-1} solution. The films were characterized by FTIR, XRD and cyclic voltammetry. Essays by FTIR confirmed the presence of the ppy film on FTO electrode through the typical absorption bands of polymer. The presence of dopant material (Ni(OH)$_2$) in the polymer matrix was verified by XRD, where there is the characteristic diffraction peaks of the secondary phase, and by cyclic voltammetry in 0.1 mol L^{-1} of KOH solution, which is observed an oxidation peak around 0.62 V *vs*. Ag/AgCl (3.0 molL^{-1} KCl) of the redox couple Ni^{2+}/Ni^{3+}. Cyclic voltammograms obtained in 0.1 mol L^{-1} of KCl solution showed that the doped film has higher values of capacitive current in the region of potential considered, due more active area. Measurements of different amounts of ascorbic acid was evaluated by cyclic voltammetry and chronoamperometry and results show that both films present great sensitivity towards the ascorbic acid, 83.8 mA L mol^{-1} cm^{-2} and 133.4 mA L mol^{-1} cm^{-2} for Ppy and Ppy/Ni(OH)$_2$, respectively. Accordingly, to the results these films are attractive and alternative materials in construction and architecture design of an amperometric sensor ascorbic acid species concerning the great biological interest.

References

[1] Pinnel, S. R.; Murad, S.; Darr, D. *Arch. Dermatol.* 23 (1987) 1684-1886.
[2] Casella, I. G.; Guascito, M. R. *Electroanalysis* 9 (1997) 1381.
[3] Özcan, L.; Sahin, M.; Sahin, Y. *Sensors* 8 (2008) 5792-5805.
[4] Vidotti, M.; Silva, M. R.; Salvador, R. P.; Torresi, S. I. C.; Dall'Antonia, L. H. *Electrochimica Acta* 53 (2008) 4030-4034.