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Columnar structures of polypyrrole for solid-phase microextraction

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Abstract – Polypyrrole (ppy) was electropolymerized potentiostatically by oxidation onto NiTi wires for use in solid-phase microextraction (SPME). Different thicknesses and deposition potentials were investigated, using aqueous solutions and dodecylbenzenesulfonic acid (DBSA) as dopant. Perpendicularly oriented columnar structures of PPy/DBSA were obtained, whose efficiency for extraction was higher when compared to a commercial polyacrylate (PA) fiber for the two alcohols tested.

The SPME technique developed in the early 90's by Pawliszyn [1] is a cheap technique that, combined with chromatography, brings several advantages in comparison to other analytical techniques: it isolates and concentrates analytes at trace level, ensures purity and does not compromise chemical analysis. Another advantages are that it does not require solvents, is reusable and quite robust when compared to the fragile commercial molten silica fibers.

Electropolymerization was performed potentiostatically onto NiTi wires with a diameter of 200 µm from aqueous solutions containing 0.1 mol/l pyrrole and 0.1 mol/l dodecylbenzenesulfonic acid (DBSA). Platinum foil and saturated calomel (SCE) were used as counter and reference electrodes, respectively. At potentials higher than 1.5 V/SCE the deposit developed a columnar growth (Fig. 1), leading to an increase in the effective surface area. This morphology had been previously observed in plane substrates [2]. The novelty of this work is the use of a cylindrical substrate, which enables the radial growth of the PPY/DBSA columns.

The electropolymerized coatings were tested as headspace-SPME device for extraction of 1-butanol and 1-hexanol. Thermal desorption was used to transfer the extracted analytes into the injection port of a gas chromatography. Results (Fig. 2) show that a 30 µm thick ppy coating shows a much higher sensitivity than an 80 µm thick PA fiber.

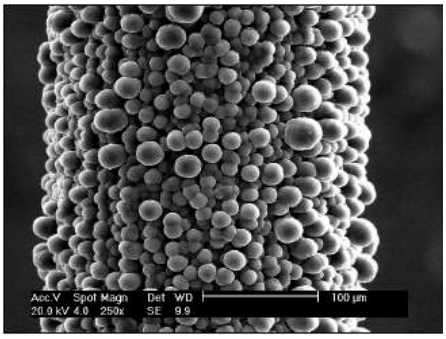

Figure 1: PPy/DBSA, 30 µm, Potentiostatic deposition at 1.5 V/SCE

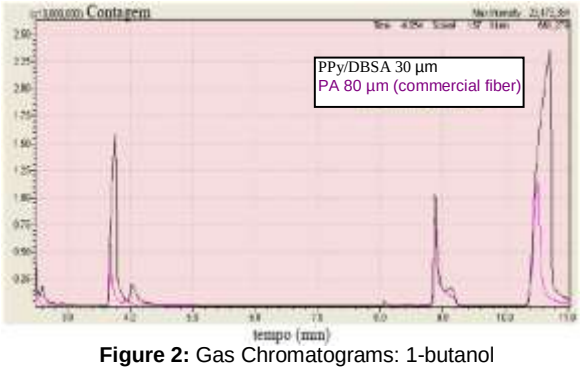

Figure 2: Gas Chromatograms: 1-butanol (3.75 min) and 1-hexanol (10.38 min)

References

[1] C. L. Arthur, J. Pawliszyn. *Anal. Chem.* **62,** (1990) 2145.
[2] K. Naoi, Y. Oura, M. Maeda, S. Nakamura. *J. Electrochem. Soc.* **142,** 2 (1995) 2.