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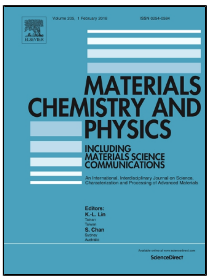

Electrochemical and structural characterization of Nafion/Bismuth-Tin nanocomposites stabilized with polyoxyethylene 23 lauryl ether (Brij)

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ABSTRACT

Nafion/Bismuth-Tin nanocomposites stabilized with polyoxyethylene 23 lauryl ether (brij) were produced in a mixture of nafion and brij dissolved in N-N dimethylformamide. Metal salts were reduced in the presence of sodium borohydride assisted by ultrasound. The average hydrodynamic diameter of polymer-metal particles was measured via dynamic light scattering (DLS) and related to the composition of the reactive mixture; growth kinetics were compared with the Liftshitz-Sloyozov-Wagner model, and we found that the polymer-tin system of nanoparticles was time stable and that the size of the nanoparticles, close to 100 nm, is not dependent on brij concentration.
The selected nanocomposites with a total metal concentration of 13% w/w were structurally characterized by means of infrared (IR) and X-ray photoelectron spectroscopy (XPS). Furthermore, the morphology and phase-metal distribution was studied via electron microscopy (SEM and TEM). The nanocomposites were used as electrodes for cadmium detection through square-wave anodic stripping voltammetry (SWASV) in a sodium acetate buffer solution. The materials with higher bismuth content allowed obtaining better results in terms of the peak current; however, the addition of tin up to 50% allows producing material with greater resistance to oxidation.

Key words: Tin, bismuth, nanoparticles, nanocomposite, electrode.

1. INTRODUCTION

Over the last few years, films of tin and bulk bismuth-tin alloys have been used as sensors for heavy-metal detection, with good performance, even better than bismuth electrodes [1]–[4]. Metal nanoparticles (MNPs) may be considered as being in an intermediate state between bulk metals and the atoms that compose them. Due to their small size, they exhibit properties (electric, magnetic, optical, and catalytic) different from the macroscopic metal and the isolated atoms, and recently, for this reason, nanostructured electrodes have been developed [5]–[9]. However, these properties may be transient; this means that instability is possible in this kind of material, so the stabilization of MNPs is needed for the following