Abstract #2650, 224th ECS Meeting, © 2013 The Electrochemical Society

Preparation and characterization of microcomposite based on environmentally sensitive microgel and conducting polymer

M. Karbarz, M. Mackiewicz, T. Rapecki, Z. Stojek

Faculty of Chemistry, University of Warsaw
Pasteura 1, PL-02-093 Warsaw
karbarz@chem.uw.edu.pl

Combination of a polymeric hydrogel and a conducting polymer allows obtaining materials that exhibit the properties characteristic for both components. Polymeric hydrogels are able to absorb a considerable amount of water. A very attractive property of these materials is their volume phase transition (shrinking, removal of most of water) that can be triggered by a small change in the environmental conditions. These environmental factors include temperature, pH, ionic strength and the presence of specific ions.

Regarding the conducting polymers, they are also of great interest due to good conductivity, low operation voltage and good environmental stability. However, conducting polymers have some limitations: poor mechanical properties and low solubility in common solvents. Combination of a conducting polymer with a polymeric hydrogel may lead to a composite material characterized by useful mechanical properties, better solubility and improved conductivity.

A new type of microcomposite suggested by us is based on an environmentally sensitive microgel, poly(N-isopropyl-acrylamide), and a conducting polymer, polyaniline (PANI). It was synthesized using a two-step procedure. First, NIPA microgel was prepared via surfactant-free emulsion polymerization (SFEP), and then the prepared microgel was filled with a solution of the oxidizing agent. Next the gel was placed in a solution of aniline in nitrobenzene. The structure, morphology and size of the gel microbeads were determined by SEM, TEM (see Figure 1) and DLS.

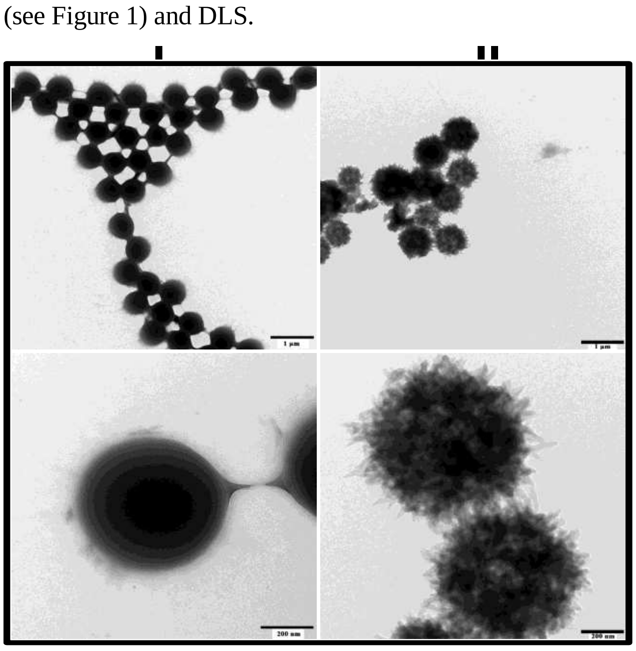

Figure 1. TEM images of (I) NIPA microgel and (II) PANI/NIPA microcomposite.

The microcomposites were characterized using voltammetry. The voltammograms obtained in a solution of NIPA/PANI microcomposite show typical signals of polyaniline obtained by electrosynthesis (see Figure 2). Moreover, the magnitude of those voltammetric signals strongly depended on the swelling state of the gel. At 20 ^{o}C hardly visible voltammetric peaks of aniline were obtained, while at 40 ^{o}C the peaks were substantially bigger and well defined.

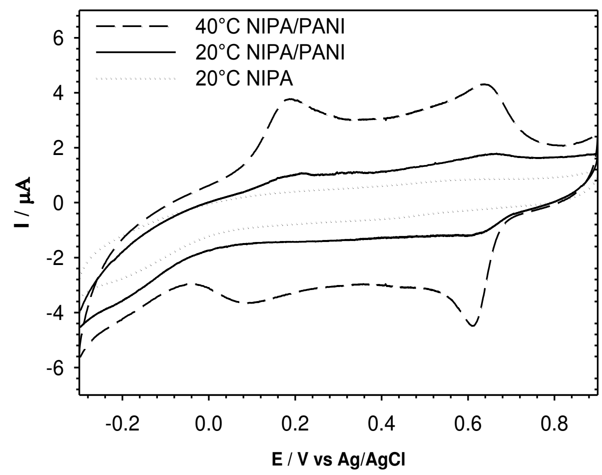

Figure 2. Cyclic voltammograms obtained with gold electrode in solution containing NIPA/PANI microcomposites at swollen state (20°C, solid curve) and shrunken state (40°C, dashed curve). Dotted curve: pure NIPA microgel. Concentration of NIPA/PANI microgel: ca. 8 mg/ml. Scan rate: 100 mV/s. Supporting electrolyte: 0.1 M $HClO_4$.