



Contribution ID: 207 Contribution code: S11-EPASE-102

Type: Oral presentation

The influence of different polyaniline polymer and carbon material morphologies on electrical properties

Monday 29 August 2022 17:00 (15 minutes)

Polyaniline powders are prepared using two different reaction routes in order to obtain different morphologies. Using ammonium persulfate (APS) as a dopant and in a solution of ethanol and acetic acid, the polymerisation of aniline gave rise to tubular like nanostructures, thus the sample was named PANI-T. Similarly, PANI-R (polyaniline with a “round” morphology of nanostructures), was synthesized in a sulphuric acid solution and with APS as a dopant. The different morphologies of the polymer species were confirmed using scanning electron microscopy (SEM). In order to obtain the carbonic materials, the polymers were raised to 900°C under N₂ constant flow. X-Ray Diffraction (XRD) was used to confirm the transition from polymers to nitrogen containing carbon nanostructures, which were labelled PANI-T-900 and PANI-R-900. The study of the electrical conductivities was done by two approaches: I-V characteristics, and electrochemical impedance spectroscopy (EIS) on a broad range of frequencies. The polymers PANI-R and PANI-T exhibit a typical semiconductor behaviour of their I-V curve, but the electrical conductance of PANI-R is a few orders of magnitude above the one of PANI-T. The measured values for the carbonic materials far exceed the ones of the polymers, entering the range of conductors. Out of the samples examined, PANI-T was the only one that exhibited a capacitive behaviour of the EIS Nyquist plot, while the other three showed an inductive one.

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