P-21: Sono-Electrochemical Preparation of Gold Nanoparticles for Novel SOFC Anode Materials

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The aim of this research is the preparation of a stable water suspension of gold nanoparticles, by an ultrasound assisted electrochemical process. The obtained nanoparticles are going to be used to improve durability and efficiency of SOFC anode cermets against degradation phenomena arising from carbon and sulfur containing compounds in the feed.

In the last decades nanostructured materials have broad applications in the fields of catalysis, including SOFCs, as well as semiconductors, cosmetics and pharmaceutical products, coatings, polishing. Nanosized noble metals possess novel physicochemical properties, which differ significantly from macroscopic metal phases and so their potential applications. The design and preparation of novel nanomaterials with tunable physical and chemical properties, as a result of the large surface to volume ratio of the nanoparticles, has received extreme intention (Aqil et al. 2008).

Many synthetic methods have been reported to prepare nanoparticles, but only few of them are versatile enough to tune the nanoparticle size in a range of several tens of nanometers while preserving monodispersity of particle size distribution. Electrodeposition process combined with high intensity ultrasound pulses has been proposed for the synthesis of large amount of nanoclusters with narrow distribution. This technique allows intensive control of the size and composition of the particles over a wide range. There is a variety of controllable parameters that can tune the nanoparticles characteristics (Aqil et al. 2008). Aqil et al. reported a pulsed sonoelectrochemical method process for preparation of gold nanoparticles where the current pulse was followed from an ultrasound pulse under the presence of polymer stabilizers. Q.Shen et al. reported a pulsed soloelctrochemical method for the synthesis of stabilize-free gold nanoparticles. Yu-Chuan Liu et al. reported an electrochemical ORC roughening procedure followed, by a stabilize-free sonoelectrochemical reduction to obtain gold nanoparticles.

The experiments presented in this report were carried out under potentiostatic conditions. Two approaches were tried. In the first one a potential pulse was applied, on a continuously sonicated sonotrode as it is known from literature that the fundamental basis of the pulsed sonoelectrochemical technique for the production of nanoparticles is massive nucleation density of metal nuclei on the sonoelectrode surface, so the deposition time was tuned.

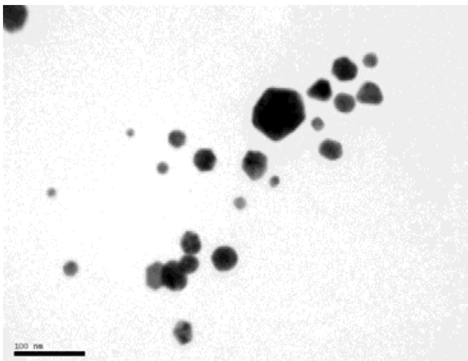

Fig. 1: Au-NP synthesized via pulsed electro-deposition, under continuous sonication.

In the second approach a procedure of continuous electrodeposition under continuous sonication on the sonotrode's surface was attempted. The U/S amplitude and the potential were kept constant. Polyvinylpyrrolidone (PVP) was added, and used as received. That way the gold nanoparticles produced, are protected against aggregation (Qingming et al. 2011).

Gold nanoparticles size and form optimization as well as the yield efficiency is achieved by varying the aforementioned parameters in potentiostatic conditions (Sáez et al. 2009). Nanoparticles are characterized via DLS and TEM and result diameter of less than 50nm.

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