Pulsed electrodeposition of iron oxide nanoparticles for catalytic and advanced electrode materials applications

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Iron oxide nanoparticles are a suitable catalytic material for a wide number of applications such as contaminants removal in soil and water remediation, hazardous waste treatment or for the fabrication of carbon nanostructures[1-3]. In this presentation, we describe the electrochemical synthesis of iron nanoparticles on three-dimensional macroscopic substrates (Al, Ni, stainless steel) by pulsed electrodeposition. The purpose of this work is to control the morphology of the particles at nano- and micro-scale by tuning the electrochemical parameters (potential, pulse time, relax time and number of pulses) and by adjusting the plating media (temperature, additives, iron salts, solvents).

Iron nanoparticles were electrodeposited from solutions containing 0.01-0.2 M $FeCl_2$, $FeCl_3.6H_2O$ and $Fe(NO_3)_2.9H_2O$ in formamide, dimethylformamide, propylene carbonate (PC) and dimethyl sulfoxide (DMSO) solvents. Non-aqueous medium has been chosen because it provides a wider electrochemical window than aqueous media and is able to reach higher temperature synthesis[4,5]. Morphological and spectroscopic data of various electrochemically-synthesized forms will be discussed in conjunction with the electrodeposition parameters. Additionally, we demonstrate the use of these iron nanoparticles as growth catalyst for vertically-aligned carbon nanotubes. The catalyst/nanotube assembly has the potential to be utilized as advanced electrode materials for energy storage applications.

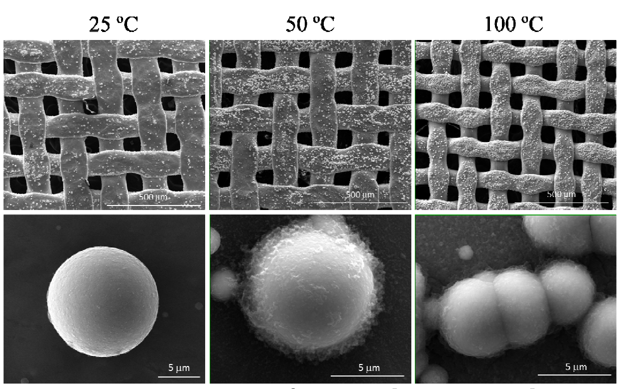

Fig. 1 SEM images of iron oxide nanoparticles synthesized via pulsed electrodeposition by using a solution 0.03 M of $FeCl_2$ in formamide solvent.

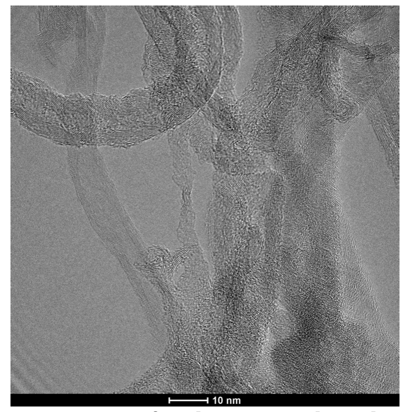

Fig. 2 TEM images of carbon nanotubes obtained via chemical vapour deposition (CVD) using the electrodeposited iron oxide as growth catalyst.

References

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