New insights on nanoparticle electrodeposition using atomic scale TEM & in situ synchrotron SAXS and modelling

Novos conhecimentos sobre a eletrodeposição de nanopartículas usando escala atômica TEM e synchrotron in situ SAXS e modelagem

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Abstract: Metal nanocrystals are of great interest due to their unique properties that can be tuned by adjusting their size and shape. When supported on different substrates, they find applications in different fields, such as catalysis or sensing. Electrochemical deposition allows the growth of the nanostructures in one step, directly on the final support. Hence, it has been proven effective to obtain highly electroactive nanostructures with potential for fuel cell or (bio)sensing applications. One of the key issues to benefit from the properties of supported nanostructures is to understand their formation mechanisms to achieve a good control of their morphology. However, the early stages of electrochemical nucleation and growth are still an active field of research and remain unraveled. Although the classical theory predicts that nanocrystals grow irreversibly by atomic addition until the reaction is halted, we have found proof that alternative growth mechanisms are taking place. In our work, we combine Field Emission Scanning Electron Microscopy (FESEM), aberration-corrected Transmission Electron Microscopy (TEM), electron tomography, in-situ Small Angle X-ray Scattering (SAXS) and electrochemical characterization to study the early stages of metal electrodeposition onto carbon substrates from aqueous solutions and Deep Eutectic Solvents (DESs). In addition we try to support our observations by electrochemical modelling.

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