Nano-Porous PtNPs on Si substrates obtained with galvanic displacement deposition

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Nowadays metal nanoparticles are subjected to extensive research thanks to their properties that differ from that of their bulk counterpart: the enhanced surface area makes them more reactive to certain molecules and thus they can be used for a variety of medicals and healthcare applications. Platinum is also the most widely used catalyst for many electrochemical applications, such as fuel cells or photo-electrochemical water splitting cells. Silicon is a very promising material to be used in energy conversion devices because of its abundance, non toxicity and tunable electronic properties, but the slow charge transfer and the recombination mechanism seriously hinder its performance. Modifying Si surfaces via metal nanoparticles improves the photo-electrochemical (PEC) characteristics of Si electrodes, such as their catalytic ability and stability. It is therefore clear that a detailed study on the nucleation and growth mechanism of metallic nanoparticles on the considered substrate is definitely of interest. In this work we analyze the electroless platinum deposition mechanism with galvanic displacement on Si substrates. Results, based on Rutherford Backscattering spectroscopy and electron microscopy techniques, have outlined a progressive nanoparticle nucleation with a diffusion limited growth. An advanced characterization with High resolution TEM has pointed out the unique crystalline arrangement of each cluster, showing a very peculiar nano-porous structure, as shown in fig.1.

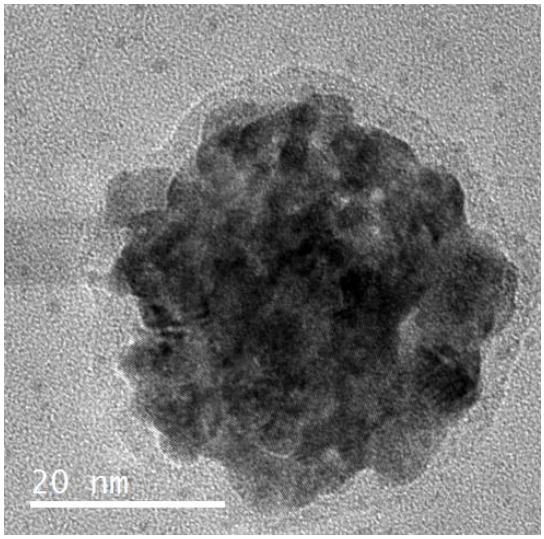

Fig 1: PtNP particles on Si(100)

[1]. B. Frabe et al Langmuir 32, 11728-11735, (2016).

[2]. R. G. Milazzo et al ECS Journal of Solid State Science and Technology 3, 235-242 (2014)