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Enhancing the Palladium Nanoclusters deposition rate with the introduction of O2 in a Gas Aggregation Source (GAS)

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Palladium nanoclusters (NCs) are an outstanding catalyst for the electro-oxidation of small organic molecules[1]. Magnetron Sputtering Gas Aggregation Source (MS-GAS) is known by producing NCs of different materials providing a continuous nanocluster beam[2,3] but a challenge of GAS is to enhance its deposition rate. NC growth is controlled by thermodynamic and kinetic factors depending on experimental parameters as total pressure or target power. Interestingly, the addition of small amounts of a reactive gas (O_2 or N_2) increased the deposition rate of different metals[4]. The aim of this work is to study the influence of O_2 addition on cluster size, crystal quality and the deposition rate during the growth of Pd NCs.
In the Pd-O_2 system, when the discharge voltage (V_d) raised, a transition zone (TZ) from a clean to a poisoned Pd target surface was detected and started at an oxygen flow rate as low as 0.030 sccm. Target poisoning affected NC size and deposition rate that reached a maximum value at the end of the TZ. While NC size varies between 3 to 6 nm, the deposition rate is enhanced almost four times. Moreover, above the TZ, it is possible to observe Janus Pd/PdO nanoclusters. Preliminary results show how the catalytic activity of Pd NC electrodes (towards glycerol oxidation) greatly depends on the O_2 addition in the Pd NC growth process.

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