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How to design catalytic nanocluster by magnetron-sputter gas-aggregation?

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Physical processes are able to produce multifunctional nanoparticles (NPs) from individual atoms. Due to the fast kinetics and the non-equilibrium mechanisms occurring in this process, the NPs properties are not controlled anymore by thermodynamic. Unconventional pathways of NPs formation are possible which can lead to complex and sophisticated NPs with various functionalities for different applications, such as magnetic, plasmonic, catalytic, gas-sensing,..

This study is focused on magnetron-sputter gas-aggregation, in which the nanoparticle synthesis is decomposed into four stages, i.e. aggregation, mass-filtration, and deposition. By combining the gas-aggregation source with a conventional magnetron deposition process, we have demonstrated that it is possible to form the core-shell PdPt@Pt catalyst on proton exchange membrane. The atomic composition and the size of the core NPs were measured by Rutherford Backscattering Spectroscopy (RBS) and transmission electron microcopy (TEM). The crystal structure were studied on the SixS line of the Sun synchrotron using grazing incidence X-ray diffraction (GIXD) and central grazing incidence X-ray diffraction (GISAXS). Integrated into a PEMFC, such core-shell NPs allows the reduction of the time necessary to obtain the fuel cell nominal power.

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