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A toolbox to study precious metal nano- catalysts: surfactant free synthesis, characterization and catalytic activity

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To develop an efficient catalyst for energy-related reactions (e.g. the oxygen reduction reaction (ORR) taking place in fuel cells), a careful control on every preparation steps is fundamental. The **synthesis** route, the **physical properties** of the obtained **nanoparticle catalyst** (e.g. composition of the catalyst, size, etc.) and further **processing and formulation** (e.g. nanoparticle loading on support, nature of the support, 'ink' formulation, etc.) can strongly influence the **catalytic performances** (e.g. maximum activity, stability, selectivity, etc.). To optimize a catalyst, it is necessary to **systematically control** and **systematically study** the effect of these different parameters.

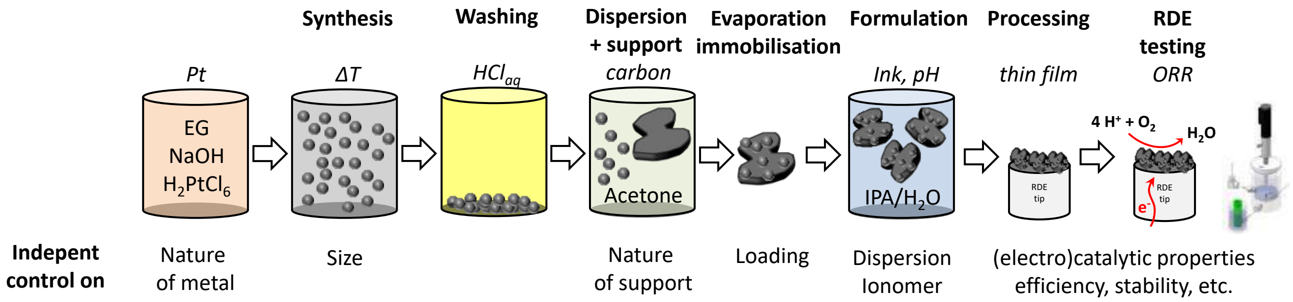

Fig. 1. Scheme of the steps in the toolbox approach to systematically study platinum catalysts for the ORR

Performing systematic studies is challenging with commercial catalysts since not all properties can be tuned independently. A **toolbox approach**[1] has been develop and shown over the years to be suitable to perform systematic studies and propose optimization strategies of platinum catalysts for the ORR.[2]

In this presentation, recent findings and development are highlighted regarding (1) the synthesis of precious metal nanoparticles (e.g. Pt) in particular regarding **size control** and developing **green synthesis** approaches[3]. (2) An overview of the **different characterization** techniques used and how they complement each other is given (e.g. Transmission electron microscopy, X-ray absorption spectroscopy, small angle X-ray scattering, and pair distribution function analysis). (3) Further **development** of the toolbox are highlighted and how a **transfer of knowledge** is/could be performed to other areas of electrocatalysis (e.g. for the oxygen evolution reaction performed in electrolyzers), of catalysis (e.g. for chemical production) or other fields of research (e.g. environmental science) is presented.

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