Catalytic monoliths with narrow particle size distribution in washcoats with well-defined gradients

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The synthesis of cluster compounds has significantly advanced, driven by their unique atomic, geometric, and electronic structures that enhance catalytic activity and stability. In addition, the scale up and testing nanoparticles (NPs) in real world applications remains challenging. This work introduces a flexible, multistage CSTR cascade platform for the continuous flow (CF) synthesis of clusters and NPs coupled with advanced coating processes as structured model catalysts for real application tests. We demonstrate the CF platform's capabilities by synthesizing $[Pt_{17}(CO)_{12}(PPh_3)_8](NO_3)_{x=1,2}$ clusters, highlighting its potential for scaling up atom-precise cluster synthesis. The platform's modularity and flexibility coupled with on-line analysis methods (DLS and UV-Vis spectroscopy) also enables the production of a broad spectrum of cluster compounds and NPs. Moreover, advanced coating techniques, including an automated washcoating process, were used for the prepartation of structures catalysts. We implemented a laboratory scale characterizing feedback loop to optimize the manual coating process allowing the investigation of applied studies on realistic systems and for example multidimensional phenomena such as sulfur poisoning.

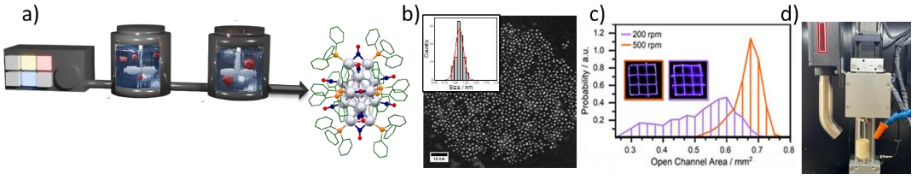

Figure 1: a) Schematic representation of the CF synthesis platform; synthesizing Pt_{17} cluster with **b)** HAADF electron micrographs **c)** density distribution (open channel areas) as part of the characterizing feedback loop and **d)** robot controlled washcoating.

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[2] T. Delrieux et al., *Chem. React. Eng.* 2024, DOI. 10.1039/D4RE00168K accepted