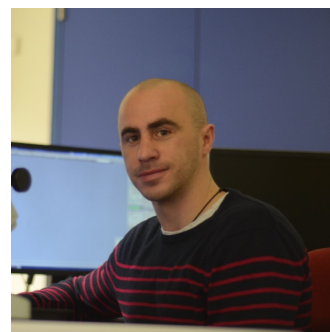


In-situ/operando TEM

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The development of in situ/operando techniques that enable characterizations of the active catalyst and associated dynamic processes under relevant catalytic conditions has become an important research topic in catalysis.¹⁻³ In our department, we have recently implemented a home-build gas-feeding system combined with a mass spectrometer (MS) for operando experiments inside the column of a conventional FEI Titan transmission electron microscope (TEM) using commercially available gas-flow TEM holders (Protochips and DensSolutions). Using this setup, we are able to monitor the dynamic changes of catalysts under controlled conditions (Figure 1; at a pressure up to 1 Bar and temperature up to 1000 °C)^{1,4} with simultaneous analysis of the gas-phase composition and the detection of catalytic conversion by MS. Our research is focused on catalytic reactions, which are under study in the department, over metal oxides as well as supported and unsupported metal catalysts under relevant conditions. The aim is to obtain key insights into the understanding of the reaction-function relationships in order to establish guidelines for a rational design of better catalysts.

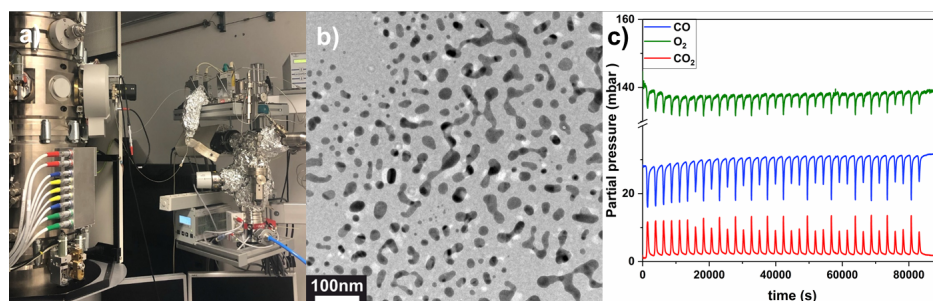


Figure 1. Home build gas-feeding system during CO oxidation reaction. a) Photograph of operando setup. b) TEM micrograph of Pt nanoparticles. c) Mass spectrometry data over 25 reaction cycles

References:

- [1] Topsøe, H., *Journal of Catalysis* **2003**, 216 (1), 155-164.
- [2] Bañares, M. A., *Catalysis Today* **2005**, 100 (1), 71-77.
- [3] Vendelbo et al., *Nature Materials* **2014**, 13, 884.
- [4] Garza et al., *Micro & Nano Letters* **2017**, 12 (2), 69-75.