EUROPEAN SYNCHROTRON RADIATION FACILITY

	Experiment title: Operando XAS study on Pt-Pd mono and bimetallic catalysts for aqueous phase reforming of methanol	**Experiment number**: CH-6262
Beamline: BM23	**Date of experiment**: from: 03/05/2022 to: 09/05/2022	**Date of report**: 05/10/2022
Shifts: 12	**Local contact(s)**: Kirill Lomachenko	*Received at ESRF:*

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Report:

During last decades, scientists have intensively studied possible substitutes for the current fossil fuels. A promising replacement is hydrogen, due to its high energy density per mass unit (even higher than that of oil and coal) and its pollution free use. In addition, it is a key compound in chemical industry. However, nowadays hydrogen is usually produced using steam/autothermal reforming of fossil resources, with a high carbon footprint. A promising alternative seems to be the Aqueous Phase Reforming (APR), a process that involves the use of oxygenated hydrocarbons derived from renewable biomass [1]. Additionally, the low temperatures and moderate pressures of this process help to avoid the energy-consuming evaporation step of the counterpart steam reforming reactions. In the APR process, the oxygenated compounds like polyols or sugars in combination are converted to produce the H_2 and CO_2. Pt-based catalysts are the benchmark for this reaction, and the use of bimetallic catalysts has attracted significant interest due to their beneficial effects, like suppressed carbon deposition or increased H_2 and CO_2 yields [2, 3].

In order to understand the synergy between the two components of bimetallic catalysts, a systematic investigation on the structural evolution of a series of Pt-Pd mono and bimetallic catalysts was conducted during aqueous phase reforming of methanol by *operando* XAS measurements at Pt L_3 and Pd K edges. The XANES and EXAFS data were recorded in transmission mode using a high-pressure *operando* cell specially developed at KIT [4]. During the *operando* experiment the catalysts were exposed to a liquid flow containing 10%w/w CH_3OH in H_2O at a pressure between 25-50 bar for approx. 8h in total. The outlet gaseous products were monitored via an online micro-GC and a mass spectrometer.

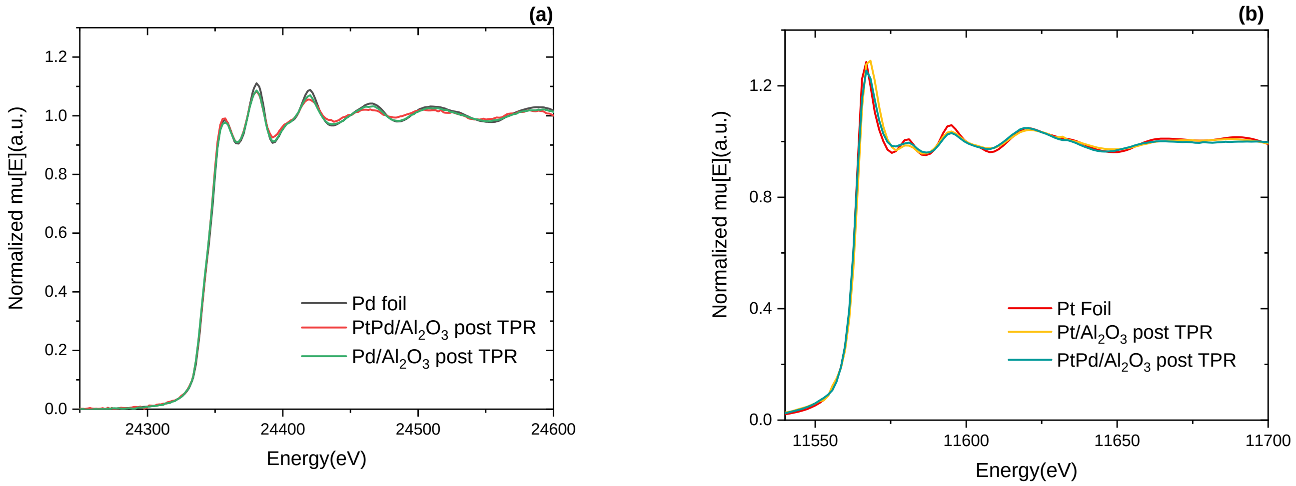

Figure 1 (a) XANES at Pd K edge recorded after H_2- activation. **(b)** XANES at Pt L3 edge recorded after H_2- activation in mono and bimetallic catalysts.

Preliminary data analysis indicate a clear impact of Pd presence, not only on the catalytic activity but also on the structure of Pt. Upon catalyst activation in a H_2-reducing atmosphere, EXAFS data analysis uncovered the formation of alloyed Pt-Pd particles, with both components in metallic state (Fig. 1). Under reaction conditions, only a minor change of the XANES profile of the spectra could be observed. A more detailed analysis of the *operando* EXAFS data is performed currently at KIT to elucidate the correlations between catalyst structure and activity.

References:

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