EUROPEAN SYNCHROTRON RADIATION FACILITY

INSTALLATION EUROPEENNE DE RAYONNEMENT SYNCHROTRON

Experiment Report Form

	Experiment title: Combined operando XAS and XRD studies on next generation alloy catalysts for the methanation of CO_2	**Experiment number**: CH-5413
Beamline: BM31	**Date of experiment**: from: 04.04.2018 to: 10.04.2018	**Date of report**: 25.02.2020
Shifts: 17	**Local contact(s)**: Hermann Emerich	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

H. Lichtenberg*, M.-A. Serrer*, K.F. Kalz, C. Fritsch*, M. Stehle*, J.-D. Grunwaldt

Report:

The results obtained during this beamtime have been published by Serrer et al. in ChemCatChem (**2019**).[1]

Abstract:
"An energy scenario, mainly based on renewables, requires efficient and flexible Power-to-X (P2X) storage technologies, including the methanation of CO_2. As active Ni^0 surface sites of monometallic nickel-based catalysts are prone to surface oxidation under hydrogen-deficient conditions, we investigated iron as "protective" dopant. A combined *operando* X-ray absorption spectroscopy and X-ray diffraction setup with quantitative on-line product analysis was used to unravel the structure of Ni and Fe in an alloyed Ni−Fe/Al_2O_3 catalyst during dynamically driven methanation of CO_2. We observed that Fe protects Ni from oxidation and is itself more dynamic in the oxidation and reduction process. Hence, such "sacrificial" or "protective" dopants added in order to preserve the catalytic activity under dynamic reaction conditions may not only be of high relevance with respect to fine-tuning of catalysts for future industrial P2X applications but certainly also of general interest."[1]

[1] M.-A. Serrer, K. F. Kalz, E. Saraçi, H. Lichtenberg, J.-D. Grunwaldt, *ChemCatChem* **2019**, *11*, 5018-5021.