

## Self-regenerating supported metal nanoparticles for CO<sub>2</sub> conversion applications

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One of the nowadays biggest challenges is how to make use of CO<sub>2</sub> for the synthesis of higher value chemicals. With this respect CO<sub>2</sub> methanation and CO<sub>2</sub>-mediated dehydrogenation of alkanes play an important role. Supported metal nanoparticles are fundamental to activate these reactions. However, during high-temperature and prolonged operation, these catalysts suffer from deactivation by sintering and surface coke poisoning.

In the present paper, the synthesis of smart, regenerative supported metal nanoparticles obtained by cationic segregation from perovskite oxide supports is shown. High-temperature treatments under reducing atmosphere lead to reduction of metal dopants and the formation of strongly anchored nanoparticles. Upon oxidation, the exsolved metal nanoparticles dissolve back into the perovskite lattice as dopant (Fig. 1). The nanoparticles are then self-regenerated during a second reduction step.

The same process applies also for bimetallic nanoparticles.

We will show that by enhancing the porosity of the parental perovskite oxide we significantly improve the ionic transport and thereby the exsolution kinetics. This effect enables to achieve better control of size and distribution of exsolved Ni and bimetallic Fe-Ni nanoparticles. The combination of socketed, regenerating Ni nanoparticles within mesoporous perovskite supports lead to improved CO<sub>2</sub> conversion to methane with respect to non-porous and commercial catalysts. In case of bimetallic systems, the size decrease and the composition variation of Fe-Ni nanoparticles showed to increase ethane selectivity in the CO<sub>2</sub>-mediated ethane dehydrogenation reaction.

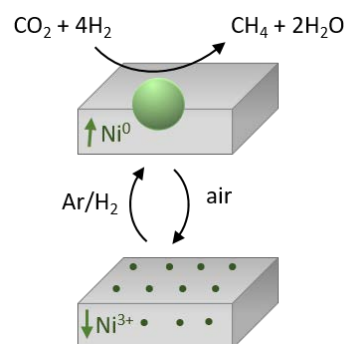


Fig. 1: Representation of the exsolution process for the synthesis of regenerative anchored Ni nanoparticles