Nanoparticle Exsolution: Tailored Catalyst Surfaces for Energy Conversion

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In heterogeneous catalysis surfaces decorated with uniformly dispersed, catalytically highly active (nano)particles are a key requirement for excellent performance. Beside the standard catalyst preparation routines, e.g. impregnation or precipitation, with limitations in terms of controlling exactly the desired catalyst structure (i.e. particle size distribution or dispersion of nanoparticles), we present here an innovative, time efficient route to exactly tailor the catalyst surface directly under reaction conditions.

Perovskite-type catalysts can incorporate catalytically highly active guest elements as dopants on the B-side. When applying reductive conditions these dopants emerge from the oxide lattice to form catalytically active clusters or nanoparticles on the surface (by exsolution), leading to a strong modification or enhancement of catalytic reactivity.

For the newly synthesized perovskite materials with different dopant elements, we could show by in-situ XRD and SEM the formation of catalytically active nanoparticles on the surface (figure 1). For reverse water gas shift reaction (rWGS) we revealed that these nanoparticles are strongly enhancing the activity. From all tested materials, cobalt doped perovskites showed the highest activity, making this catalyst highly promising for the utilization of CO_2 and its transformation into synthesis gas.

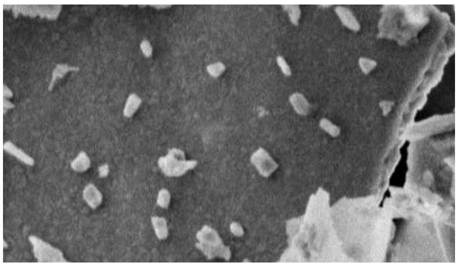

Figure 1. SEM: Fe Nanoparticle Exsolution from $La_{06}Ca_{04}FeO_3$

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