Supported Catalytically Active Liquid Metal Solutions (SCALMS) as Novel Materials for Dynamic Single Atom Catalysis

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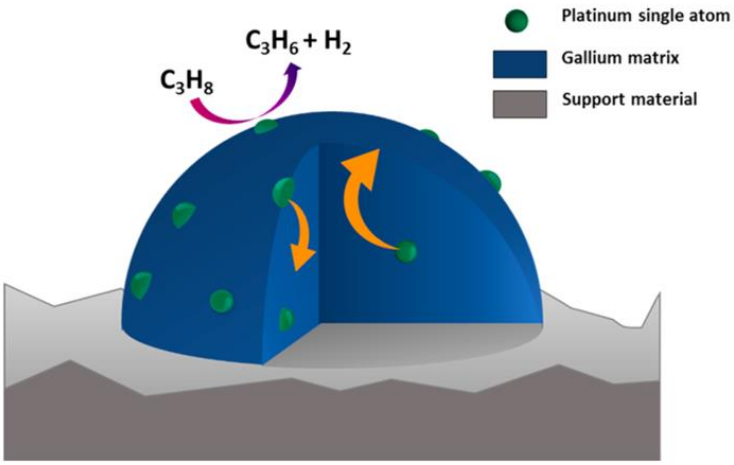
Abstract

Supported Catalytically Active Liquid Metal Solution (SCALMS) systems represent a new concept for promoting chemical reactions in a clean and sustainable manner through catalysis. In SCALMS materials, a matrix metal is doped with small amounts of (precious or non-precious) active metal.[1] The resulting is deposited in the form of very small droplets onto a porous support material. Given the right composition, these alloys become liquid at reaction temperature. We found that under these conditions single atoms of the active metal, stabilized at the liquid alloy interface, act as highly active and dynamic single catalytic sites with often unique reactivity and performance.[2] Due to the single atom nature, the SCALMS concepts allows for a very effective use of the dissolved precious metal component.



In addition, the highly dynamic nature of the liquid alloy interface prevents classical deactivation pathways, such as coking and agglomeration (sintering).[3] With these unique benefits, we could show that SCALMS systems are highly promising catalyst systems for i) the dehydrogenation of short (propane, butane) and long (heptane, methylcyclohexane) hydrocarbons, ii) the selective oligomerization of propene and butene,[4] iii) dry reforming of methane. We are convinced that further progress in SCALMS materials development will directly lead to energy and emission reductions, and thus to greener and more benign processes.

References

[1] N. Taccardi et al. Nature Chem. 2017, 9, 862.
[2] N. Raman et al. ACS Catal. 2019, 9, 9499.
[3] O. Sebastian et al. ChemCatChem 2020, 12, 4533.
[4] A. Søgaard et al. Cat. Sci. Technol. 2021, 11, 7535.