# A Synchrotron Look Into The Lifecycle Of Pt-In Catalysts

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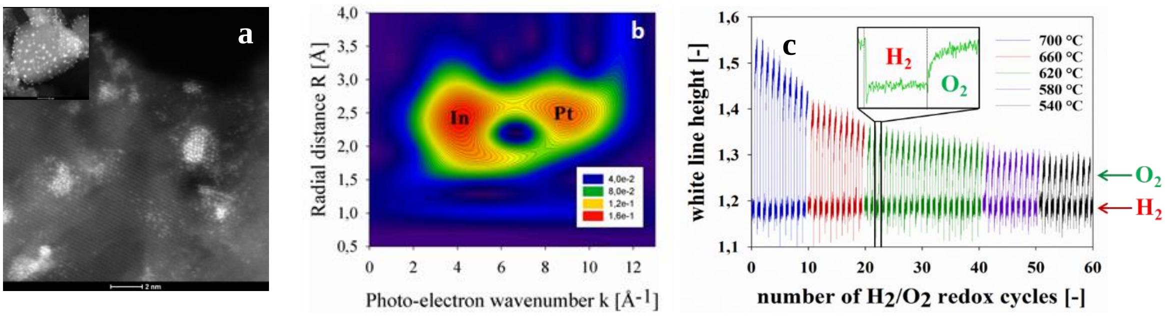
## ABSTRACT

Since their early discovery, bimetallic nanoparticles have become important in various research fields, including heterogeneous catalysis. Catalysts like Pt-In are highly demanded for their properties, e.g. in propane dehydrogenation. The nanoparticle size and composition strongly impact the nanoparticle's performance. The compositional flexibility of layered double hydroxide materials (LDH) can provide a route towards highly performing Pt-based catalysts with tuneable physicochemical properties. Pt(acac)$_2$ impregnated on a Mg(In)(Al)O$_x$ support, prepared with incorporated In, forms 1.5 nm Pt-In nanoparticles after calcination and subsequent $H_2$ reduction[1]. Their catalytic performance and life-time evolution were assessed using fast redox cycles at different temperatures.

As a further step towards controlled production of bimetallic Pt-In catalysts, a one-pot synthesis was explored, based on Mg,Al,Pt,In-containing layered double hydroxides[2]. Aside from their straightforward synthesis, these Pt–In catalysts exhibit superior propane dehydrogenation activity compared to their multi-step synthesized analogues.

An alternative route to atomically-precise synthesis of bimetallic nanoparticles, containing both noble and non-noble metals like Pt-In, can been achieved by atomic layer deposition (ALD). A bimetal ALD approach was developed for the tailored synthesis of bimetallic nanoparticles, using sequential ALD of Pt on $In_2O_3$, followed by high-temperature $H_2$ reduction. The nanoparticles' In content can be accurately controlled over the whole compositional range, and the particle size tuned from microns down to the nanometre scale[3].




The formation and performance of these bimetallic catalysts can in part be investigated by means of standard laboratory techniques like (in situ) XRD, SEM and STEM-EDX. However, an atom-scale picture of the synthesis process and the functioning in reaction can only be delivered through operando synchrotron-related techniques, such as (Q)XAS (Figure). The latter allow for a true insider's look into the elemental rearrangements that take place.

## REFERENCES

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