

Dynamics and Mobility of Nanoparticles in Heterogeneous Catalysts

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Nanometer sized particles constitute the active phase in heterogeneous catalysts, such as those used in automotive exhaust pollution control, in energy conversion and for synthesis of chemicals. The unique properties of heterogeneous catalysts, their activity and selectivity, depend on the size and composition of nanoparticles. Since catalysts are used at elevated temperatures, these nanoparticles undergo coalescence and ripening leading to particle growth. Understanding and controlling these growth processes is critical since supplies of precious metals (such as Platinum, or Gold) are limited and demand keeps increasing, for example in fuel cells.

Fundamental understanding of catalyst deactivation via sintering requires careful experimental work using a combination of ex-situ and in-situ studies. Ex-situ studies allow us to map out global rates and kinetics of particle size evolution. For this purpose, we have used a combination of TEM, STEM, XRD, chemisorption and reactivity measurements. In-situ observations can reveal nanoparticle dynamics and are crucial to bridge the gaps in our understanding, often revealing unexpected events. In this presentation, we will highlight our current state of understanding of sintering phenomena in heterogeneous catalysts.

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