What makes a catalyst active? Insights from IR nanospectroscopy measurements on single nanoparticles

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The development of optimized (electro)catalysts that can address the grand energy challenges of the 21st century requires in depth understanding of the basic elements that direct the reactivity of catalytic nanoparticles. In this talk I will demonstrate that structure-reactivity correlations within single catalytic nanoparticles can be identified by conducting Infrared nanospectroscopy measurements, while using N-heterocyclic carbene molecules as probes for surface-induced reactivity.[1-3] Using this approach, we detected the influence of different surface sites on the catalytic reactivity of Au and Pt particles and the ways by which site-dependent reactivity and selectivity varies in response to reaction conditions. In addition, by conducting Infrared nanospectroscopy measurements we uncovered the influence of communication between neighboring surface sites on the nanoscale and globular reactivity pattern [4]. These findings provide fundamental understating about the elements that direct the catalytic reactivity of metallic nanoparticles to offer guidelines for the design of optimized catalysts.

References

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Figures

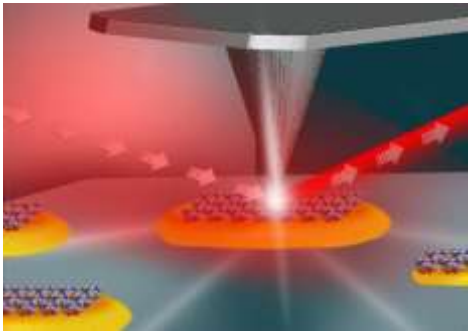

Figure 1: High spatial resolution mapping of catalytic reactivity on the surface of single nanoparticles was achieved by probing the chemical signature of reactant molecules using tip-enhanced IR nanospectroscopy measurements.