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Mapping catalytic reactions on single nanoparticles

John van Geuns Foundation Lecture by

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Catalytic nanoparticles are heterogeneous, which means that even the simplest ones show structural and compositional differences that affect the overall catalyst performance. Thus, obtaining non-disruptive, detailed chemical information at the nanoscale is essential for understanding how surface properties direct the reactivity of catalytic nanoparticles. Here we show that structure-reactivity correlations can be identified within single catalytic nanoparticles by conducting Infrared nanospectroscopy measurements, while using N-heterocyclic carbene molecules as probes for surface-induced reactivity. Using this approach, we show that the particles' periphery, containing high density of low-coordinated metal atoms, is more active in catalysing oxidation as well as hydrogenation reactions. These results provide in-depth understanding of the elements that control the reactivity of heterogeneous catalysts, enabling the development of optimized catalysts based on rational design.

References

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Elad Gross *is Assistant Professor at the Hebrew University of Jerusalem, Israel. His research focuses on the development and utilization of high spatial and high temporal resolution spectroscopy measurements of catalytic reactions. He was the first to identify catalytic reactions on the surface of single nanoparticles by using IR nanospectroscopy measurements (Nature 2017). Elad recently received the ERC Starting Grant to study catalytic reactions on single nanoparticles. In 2018, he was awarded the Krill award by the Wolf foundation.*