

## UNRAVELLING ULTRAFAST SURFACE DYNAMICS ON NANOPARTICLES

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Stanford PULSE Institute, Stanford University, & LCLS, SLAC National Accelerator Laboratory, Menlo Park, CA, USA Understanding surface charge and energy transfer dynamics on nanoparticles is crucial for advancing catalysis. We developed time-resolved reaction nanoscopy with femtosecond temporal and nanometer spatial resolution, to visualize surface charge redistribution and its correlation with bond softening. Complementary multiscale quantum simulations based on non-adiabatic quantum molecular dynamics revealed ultrafast charge transfer processes. Multimodal experiments at EuXFEL and SwissFEL combined momentum-resolved charged particle emission with coherent diffraction imaging. Our findings, enabled by free-electron lasers, highlight future opportunities for exploring nanoscale charge and energy dynamics with ultrashort, bright pulses.



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