



KEMIJSKI INSTITUT

Vabilo na Pregov kolokvij / Invitation to the Pregl colloquium

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Četrtek / Thursday, 15. 1. 2026, ob / at 13:00

Velika predavalnica Kemijskega inštituta /

Great Lecture Hall
National Institute of Chemistry
Hajdrihova 19, Ljubljana, Slovenia

Single-Atom Catalysis for Greener Fine Chemical Synthesis

The fine chemical industry faces increasing pressure to adopt more sustainable, selective, and atom-efficient synthetic routes. Single-atom catalysts (SACs) are a disruptive solution, combining the precision of molecular catalysts with the robustness and reusability of solid materials. Building on this potential, our group is developing SACs that do more than just mimic homogeneous sites: they adapt, switch reactivity modes, and enable new transformations that were previously challenging or inaccessible in heterogeneous systems. This lecture outlines our journey through the design, application, and understanding of SACs in the context of scalable, sustainable fine chemical manufacturing. The lecture will begin by elucidating the local coordination of isolated metal atoms (Zn, Cu, Ni, Ag, Pd, Ir) through XAS, FTIR, aberration-corrected STEM, and DFT, revealing well-defined and often unexpected geometries where support composition and texture dictate both dispersion and electronic properties. This precise understanding of structure enables the rational deployment of SACs across a broad range of reactions, including CO₂-assisted cycloaddition, light-driven pollutant degradation, C–O/C–C coupling, click chemistry, and C–S coupling, outperforming conventional catalysts by enabling isolated, selective, and tunable reactivity under mild conditions. Key to their function are confinement effects, charge-transfer interactions, and coordination anisotropy. These insights culminate in adaptive systems like Pd SACs with switchable reactivity and a multifunctional Ir SAC that achieves selective reductive couplings, showcasing the unique capacity of SACs to deliver efficient and sustainable catalysis guided by atomic-scale design.



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Vljudno vabljeni / Kindly invited