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CBE Seminar Abstract

Redox stability of Pt single atom catalysts on doped ceria supports

Platinum (Pt) is used extensively in catalysis as an active yet highly expensive metal. Conventionally, Pt nanoparticles are deposited onto inexpensive supports, like silica or alumina. Only Pt atoms on the surface of these nanoparticles interact with chemical reactants and facilitate chemical reactions. Thus, Pt atoms on the interior of nanoparticles are essentially wasted. Even exceedingly small particles 5 nanometers in diameter waste approximately 50% of this expensive metal. We have thus studied the synthesis and stabilization of Pt single atom catalysts, which expose every Pt atom and maximize material efficiency. Previous work in our group found that single Pt atoms may be trapped at ceria step edge defect sites after high temperature aging in air. However, these atoms sinter into nanoparticles under reducing conditions, which are common in Pt-facilitated catalysis. Here, we find that doping ceria with transition metals induces unique defect sites. With the right dopant, Pt sintering is prevented, and Pt single atoms and small clusters are maintained, even under severe reducing conditions. Further, these catalysts are synthesized using a benign one-pot synthesis procedure. This catalyst design avoids chemical waste and health hazards while reducing our dependence on a precious metal resource.