

Atomically dispersed iron hydroxide anchored on Pt for preferential oxidation of CO in H₂

With the support by the National Natural Science Foundation of China, the collaborative research teams from the University of Science and Technology of China led by Prof. Lu JunLing (路军岭), Prof. Wei ShiQiang (韦世强) and Prof. Yang JinLong (杨金龙), recently reported a new type of catalyst with atomically dispersed iron hydroxide anchored on Pt nanoparticles, which exhibits exceptionally high catalytic performance in the preferential oxidation of CO in hydrogen (PROX) reaction, by achieving complete CO removal with 100% CO selectivity over an unprecedented broad low-temperature range of 198–380 K, making the system promising for applications. This work was published in *Nature* (2019, 565: 631–635).

One problem in proton-exchange membrane fuel cells (PEMFCs), a promising candidate for next-generation power sources in vehicles, is that the platinum electrodes can quickly become poisoned by CO impurities (typically $\sim 1\%$) in the hydrogen fuel. Efficient on-board hydrogen purification, by PROX, requires development of a catalyst active and selective towards CO oxidation over a broad low-temperature range, so that CO can be efficiently removed (below 50 ppm) during not only continuous PEMFC operation (~ 353 K) but also in the frequent cold-start periods and under freezing conditions. However, the above demand represents a grand challenge due to competing hydrogen oxidation.

The new catalyst of atomically dispersed iron hydroxide $[\text{Fe}_1(\text{OH})_x]$ species anchored on silica supported Pt nanoparticles was fabricated using atomic layer deposition (ALD), by exploiting the self-limiting nature of sequential surface reactions and the steric hindrance between the chemisorbed iron precursors. *In situ* X-ray adsorption fine structure spectroscopy confirmed that isolated $\text{Fe}_1(\text{OH})_3$ was formed on the Pt particle surface under the PROX reaction conditions. Calculations further illustrated that the $\text{Fe}_1(\text{OH})_3$ moiety can readily react with CO and facilitate the sequential oxygen activation. Given that metal-oxide interfaces often play essential roles in heterogeneous catalysis, their findings open new avenues for designing highly active metal catalysts for other catalytic reactions.

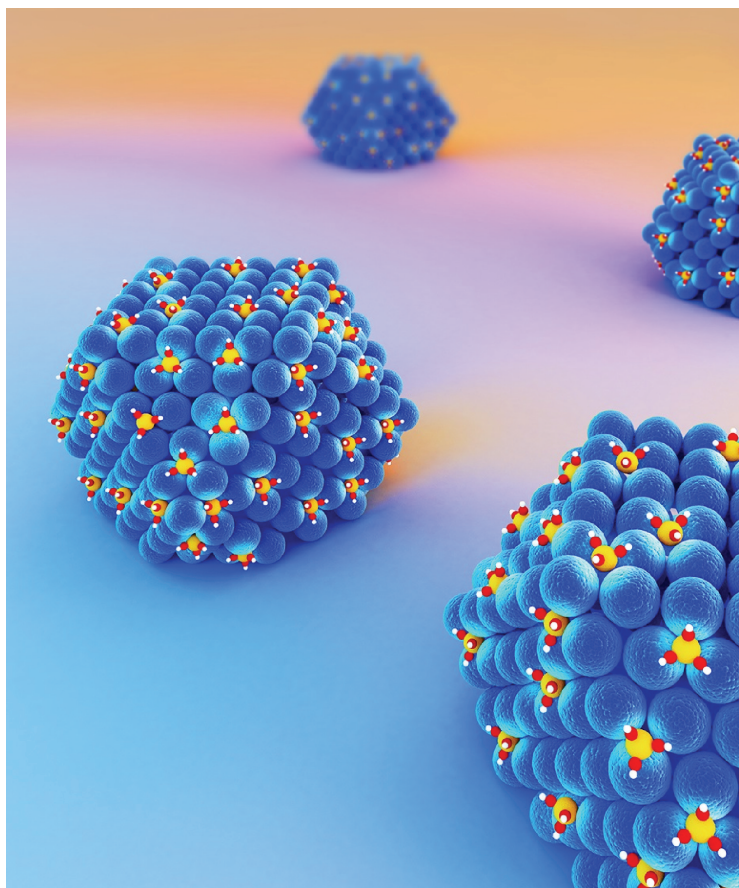


Figure Schematic illustration of the new structure of atomically dispersed iron hydroxide anchored on Pt nanoparticles.