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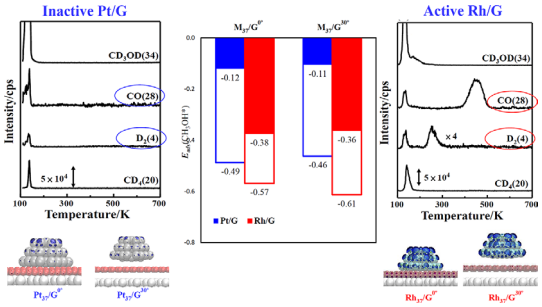
A new article investigates the reactivity and size dependence of platinum and rhodium nanoclusters in the catalyzed decomposition of methanol-d4.



Nanoclusters can exhibit properties very different from those of larger nanoparticles or bulk materials. In particular, nanoclusters supported on graphene have been extensively studied as a possible electrode for solar cells or fuel cells, as well as a catalyst for various chemical reactions.

A new article investigates one of these reactions — catalyzed decomposition of an isotropic variant of methanol — to learn about the reaction mechanism and potential correlations between reactivity and structure of the catalysts. This reaction plays a key role in direct methanol fuel cells, which convert the chemical energy of liquid methanol into electricity.

In an experiment, the researchers grew a graphene film on a clean platinum surface. The sample was then quenched for vapor deposition of platinum and rhodium. The resulting nanoclusters had a mean diameter of 2.0 to 3.5 nm. They exposed the sample to methanol-d4 gas to observe the catalyzed decomposition with temperature-programmed desorption and infrared reflection-absorption spectroscopy.

They observed that methanol-d4 on platinum nanoclusters did not decompose, which contrasts previous results on extended platinum surfaces and platinum nanoclusters supported on aluminum oxide or nickel aluminide.

The results challenge the idea that transition metals become more reactive when they are scaled down in size. The researchers argue this occurred with platinum nanoclusters because the adsorption energies of methanol decrease significantly on most surface sites of the clusters. In comparison, they did not see this effect for rhodium nanoclusters, which showed a reactivity similar to that of extended rhodium surfaces because the adsorption energies of methanol-d4 on both are comparable.

The contrasting results between platinum and rhodium nanoclusters suggest that transition metal reactivity evolves with size in a manner largely dependent on their electronic nature.

Source: "Distinct dependence on size of Pt and Rh nanoclusters on graphene/Pt(111) in the decomposition of methanol-d4," by A. S. Ansari, Zhao-Ying Chern, Pei-Yang Cai, Yen-Wen Huang, Guan-Jr Liao, Jenghan Wang, and Meng-Fan Luo, *Journal of Physical Chemistry* (2019). The article can be accessed at http://doi.org/10.1063/1.5125464.