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Influence of Charge Transport of Pt-CdSe-Pt Nanodumbbells and Pt Nanoparticles/GaN on Catalytic Activity of CO Oxidation

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Among multicomponent nanostructures, hybrid nanocatalysts consisting of metal nanoparticle-semiconductor junctions offer an interesting platform to study the role of metal-oxide interfaces and hot electron flows in heterogeneous catalysis. In this study, we report that hot carriers generated upon photon absorption significantly impact the catalytic activity of CO oxidation. We found that Pt-CdSe-Pt nanodumbbells exhibited a higher turnover frequency by a factor of two during irradiation by light with energy higher than the bandgap of CdSe, while the turnover rate on bare Pt nanoparticles didn't depend on light irradiation. We also found that Pt nanoparticles deposited on a GaN substrate under light irradiation exhibit changes in catalytic activity of CO oxidation that depends on the type of doping of the GaN. We suppose that hot electrons are generated upon the absorption of photons by the semiconducting nanorods or substrates, whereafter the hot electrons are injected into the Pt nanoparticles, resulting in the change in catalytic activity. We discuss the possible mechanism for how hot carrier flows generated during light irradiation affect the catalytic activity of CO oxidation.

Keywords: Metal-semiconductor junction, Metal-oxide interface, CO oxidation, Catalytic activity, Hot electron flow, GaN doping