**Metal-Support Interactions Between Pt and Reduced CeO$_x$(111)**

D.R. Mullins and K. Zhang (Oak Ridge National Laboratory)

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**Introduction:** Pt and Rh are the principal active metals in automotive exhaust catalysts. These metals are frequently supported on CeO$_2$. In previous studies we have determined that reduced CeO$_x$ enhances the activity of NO and CO decomposition on supported Rh compared to bulk Rh. It is also well known that Pt is encapsulated by the support when it is on reduced TiO$_2$. The current study was designed to determine whether reduced ceria enhances the activity of Pt or if encapsulation occurs.

**Methods and Materials:** Highly ordered CeO$_x$(111) films were prepared by evaporating Ce onto Ru(0001) in an oxygen ambient of ca. 10$^{-9}$ torr. The oxidation state of the ceria was controlled by adjusting the O$_2$ pressure and determined from the Ce 4d core-level spectra. Sub-monolayer amounts of Pt were evaporated onto the ceria surface at 300 K and progressively annealed to 900 K. The Pt was characterized by Pt 4f photoemission. The samples were exposed to CO at 200 K after they were annealed to different temperatures. The adsorbed CO was characterized by C 1s core-level spectra.

**Results:** The Pt 4f spectra on oxidized and reduced ceria are shown in **Figure 1**. The samples were annealed to 600 K to remove small amounts of CO that adsorbed on the Pt at 300 K during evaporation. On CeO$_2$, the Pt 4f signal is virtually unchanged when the sample is annealed from 600 K to 900 K (**Figure 1a**). This indicates that the Pt particles did not agglomerate or become encapsulated by the ceria upon annealing at 900 K. When the Pt was annealed from 600 K to 900 K on reduced CeO$_x$, the Pt intensity decreased by ca. 50% suggesting that the Pt is encapsulated by the reduced ceria or agglomeration occurs.

C 1s spectra from CO adsorbed on Pt supported on ceria are shown in **Figure 2**. On oxidized CeO$_2$ there is only a small decrease in the amount of CO adsorbed after the sample is annealed to 900 K (**Figure 2a**). The amount of CO that can adsorb on the Pt is decreased by ca. 70 % when Pt on reduced CeO$_x$ is annealed to 900 K (**Figure 2b**). This is consistent with the Pt 4f spectra and supports the conclusion that the Pt is substantially covered by the CeO$_x$ or that the Pt surface area is much smaller. There is no evidence of CO dissociation in the C 1s spectra any temperature, which indicates that the Pt is not activated on reduced CeO$_x$.

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