The use of heterogeneous catalysis is well established in chemical synthesis, energy, and environmental engineering applications. Supported Pt nanoclusters have been extensively reported to act as catalysts in a wide number of chemical reactions.

In this study, the performance of Pt/ZrO$_2$ nanocatalyst is investigated for the decomposition of methanol, ethanol, 2-propanol, and 2-butanol. The potential of each alcohol for the production of H$_2$ and other relevant products in the presence of a catalyst is studied. All the alcohols studied show some decomposition activity below 200$^\circ$C which increased with increasing temperature. In all cases, high selectivity towards H$_2$ formation is observed. With the exception of methanol, all alcohol conversion reactions lead to catalyst deactivation at high temperatures (T >250$^\circ$C for 2-propanol and 2-butanol, T >325$^\circ$C for ethanol) due to carbon poisoning. However, long-term catalyst deactivation can be avoided by optimizing reaction conditions such as operating temperature.

In addition, the performance Pt/γ-Al$_2$O$_3$ is evaluated in the oxidation of 2-propanol. Pt nanoclusters of similar size (~1 nm diameter) but different structure display distinctively different catalytic properties. All the systems studied achieve high conversion (~ 90%) below 100$^\circ$C. However, flatter particles display a lower reaction onset temperature, demonstrating superior catalytic performance. Acetone, CO$_2$, and water are generated as products indicating that both partial and complete oxidation are taking place.

A number of techniques including AFM, XPS, TEM-HAADF, XAFS as well as packed-bed reactor experiments were used for sample characterization and evaluation of catalytic performance.

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Approved for distribution by Beatriz Roldan Cuenya, Committee Chair, on March 18, 2010.

The public is welcome to attend.