PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

CLEAN FUELS & CHEMICALS

In-situ EXAFS and XPS studies of unpromoted and noble metal-promoted Co/Al_2O_3

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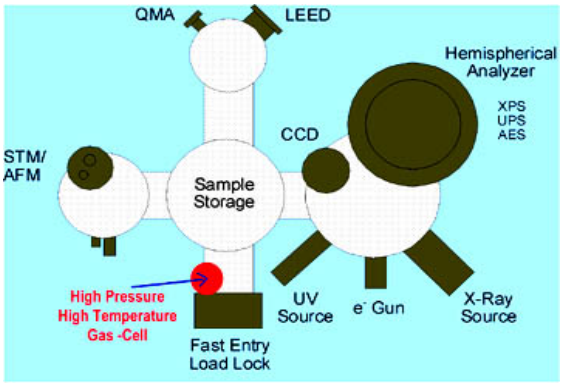
Unpromoted Co/Al_2O_3 catalysts are compared with Co/Al_2O_3 promoted with noble metals such as platinum, rhenium, and ruthenium. There is a strong metal-support interaction with cobalt, which hinders the kinetics of the reduction process with the unpromoted catalysts. Therefore, we are utilizing noble metals to catalyze the reduction of Co species interacting with the alumina support. Using in-house techniques at the CAER such as temperature programmed reduction (TPR) and hydrogen chemisorption with pulse re-oxidation, we were able to demonstrate that the role of the noble metal was to improve the extent of reduction of cobalt. Furthermore, improved activities (~ double) were demonstrated by testing in the CSTR reactor.

More recently, we have direct evidence of this improved reduction using XPS with the aid of the in-situ flow cell at U of L (see picture below). Samples were treated in hydrogen, and subjected to evacuation prior to scanning at various reduction temperatures. The Pt and Re promoted samples showed improved cobalt reduction versus the unpromoted. Similar findings were obtained by conducting in-situ experiments using in-situ XANES and EXAFS. High-resolution TEM of unpromoted Co/Al_2O_3 is also illustrated below and shows a high degree of crystallinity for the Co grains with d-spacings suggesting cubic oxide phase. HRTEM and STEM of Pt and Ru promoted Co/Al_2O_3 are in progress.



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