

Morphological dependence of ZnO on methanol steam reforming activity in Pd/ZnO catalysts

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Pd/ZnO catalysts have been shown to be highly active for methanol steam reforming and selective towards production of CO₂ and H₂. Whereas typical production methods decompose a metal precursor directly on the oxide support, our method relies upon *ex-situ* synthesis of colloidal nanoparticles as the Pd component. This method provides a more uniform particle size distribution and avoids damage to the ZnO as seen in acidic precursor solutions. Damaged ZnO, seen in previous work, introduces an additional factor to the activity of the catalyst. Catalysts based on amorphous ZnO are less active than ones supported on faceted ZnO, which suggests that the morphology as well as the chemistry contribute to the overall activity. While it is well known that the PdZn alloy is active towards methanol reforming ($\text{CH}_3\text{OH} + \text{H}_2\text{O} \rightarrow \text{CO}_2 + 3\text{H}_2$) instead of decomposition ($\text{CH}_3\text{OH} \rightarrow \text{CO} + 2\text{H}_2$), it is not clear how the ZnO support is involved. This work addresses the role of ZnO by systematically investigating the activity of samples prepared from faceted ZnO of differing morphology (nanorods and platelets), etched and reprecipitated ZnO. Pd deposition on each support was carried out by using both preformed nanoparticles as well as incipient wetness with a Pd(OAc)₂ precursor for comparison. We used CO oxidation activity to quantitatively determine the number of active Pd sites, and methanol steam reforming after forming PdZn particles in the reactor. These results show that the ZnO surface morphology plays a significant role in affecting the reactivity of Pd based steam reforming catalysts.

This work has been supported by the United States Department of Energy, Office of Basic Energy Sciences under contract number DE-FG02-05ER15712 (University of New Mexico) and DE-AC0494AL85000 (Sandia National Laboratories). Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company for the United States Department of Energy.