PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

BIOFUELS & ENVIRONMENTAL CATALYSIS

Novel Concepts for Low Temperature Hydrocarbon Selective Catalytic Reduction (HC-SCR) of NOx: Catalyst Development

This project aims to develop Pt/carbon nanotube materials as active, selective and oxidation-resistant LT HC-SCR catalysts. Given that one of the main weaknesses of HC-SCR technology is the very limited temperature range of operation of HC-SCR catalysts, we have proposed an approach based on dual SCR catalysts, corresponding to low temperature (LT) and high temperature (HT) formulations, with exhaust gas switching to utilize the appropriate catalyst based on gas temperature. Based on current leads, platinum supported on activated carbon appears to be one of the most active HC-SCR catalysts in the LT range (150-250 °C). However, a major concern associated with the use of Pt/carbon catalysts is the propensity of the carbon support to undergo combustion in oxidizing environments. Therefore, the use of multi-walled carbon nanotubes (MWNTs) as a catalyst support was investigated and found to yield catalysts with a higher resistance to oxidation.

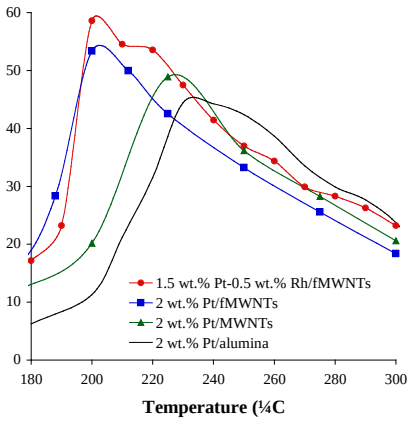

Figure 1. Comparison of NOx conversion over MWNT-supported Pt and Pt-Rh catalysts and Pt/Al_2O_3.

As shown in Fig. 1, MWNTs-supported Pt is found to exhibit superior NOx reduction performance (with propene as reductant) compared to Pt on alumina. The effect of alloying of Pt with Rh and/or Ir on catalytic performance was also studied after first confirming by means of STEM-EDS that particles as small as 1 nm in these catalysts are true alloys (Fig. 2). A catalyst with acid functionalized multi-walled carbon nanotubes (fMWNTs) as support and 3:1 Pt:Rh (by weight) as the active phase showed the highest and widest deNOx activity overall (Fig. 1).

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Figure 2. Scanning Transmission Electron Micrograph of 1 wt.% Pt - 1 wt.% Rh/fMWNTs and Energy Dispersive Spectrum of the highlighted region.

Current work in this project is aimed at scaling up the synthesis of the most promising catalysts found to date, using commercial metal monoliths as the catalyst substrate. The monolithic catalysts will subsequently be tested on a light duty diesel engine. In parallel, fundamental studies are being conducted to probe the mechanism of NOx reduction over these catalysts.

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SPONSORS

Coordinating Research Council (CRC)

PROJECT VALUE

CRC: $174,135
UK: $19,349

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