

Low temperature NO_x Removal from Diesel Exhaust by Coupling Ethylene Glycol Reforming with Selective Catalytic Reduction

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A major incentive to switch from gasoline engines to diesel engines is its higher efficiency in converting fuel into power. However, the three-way catalyst effective for NO_x removal in gasoline exhaust under stoichiometric air-fuel conditions is rendered ineffective under the fuel-lean conditions of diesel exhaust. A concerted effort to devise means to effectively remove NO_x emissions from diesel-powered engines to meet current emission standards has led to the development and implementation of technologies such as urea-selective catalytic reduction and the lean NO_x trap. However, these technologies have their shortcomings and efforts continue to improve them and to search for others.

We have investigated a novel strategy to achieve high NO_x removal at low temperatures in an oxygen rich atmosphere. This approach involves a coupled system, consisting of an ethylene glycol (EG) reforming unit to convert an EG-H₂O mixture into H₂ and CO followed by a H₂/CO-deNO_x unit. H₂ has been identified as one of the few reductants active for low temperature NO_x reduction recently. In our work, a Na-modified Pt/alumina catalyst was found to be effective for gas phase EG reforming with high selectivity to H₂ at 230 °C. At low EG concentrations, near complete conversions of EG to H₂ are achieved, mainly via decomposition (forming 3 moles of H₂ for every mole of EG reacted). A very interesting aspect is the ability of O₂ to prevent deactivation when the reforming reaction was conducted at higher EG concentrations.

Separately, Pd supported on titania pillared clay were synthesized and tested for H₂/CO-SCR. The effect of Pd loading on the NO reduction activity was examined. Pd particle size was found to have a significant effect on the NO reduction activity. After testing of the individual units separately, the output of the EG reforming unit was combined with a simulated exhaust stream and then sent to a deNO_x unit. The effect of the reforming conditions on the performance of the deNO_x catalyst will be discussed.



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