TEMPERATURE TRANSIENT EFFECTS IN PLASMA CATALYSIS

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Plasma discharge is used together with a combination of catalysts for simulated diesel exhaust NO_x removal. A transient evaluation is made using a programmed temperature ramp between 100°C and 500°C, and using FTIR to measure the gas composition before and after the treatment. Although the temperature transient is not directly related to any driving cycle, it has provided useful insight on plasma-catalyst system issues.

A controller was made that holds constant plasma-specific energy deposition (J/L) over the temperature range. It is necessary to vary both frequency and amplitude of the AC excitation in the dielectric barrier discharge. Surface conductivity effects on the barrier affect the discharge NO_x at higher temperatures.

Zeolite-based catalysts, such as NaY and BaY, have both steady-state NO_x conversion and significant NO_x storage. The stored NO_x can be released during catalyst heating. By themselves, these catalysts have poor conversion over the temperature cycle.

An alumina-based catalyst provided by Caterpillar has higher temperature operation than the zeolite-based catalysts. When placed downstream of BaY, the cycle average NO_x efficiency is greatly improved. This is partly because the desorption of NO_x from the BaY occurs at a temperature near the lower operating range of the alumina-based catalyst, and partly because the zeolite-based catalyst increases the concentration of formaldehyde, which is a useful NO_x reductant over the alumina-based catalyst.

A platinum-based catalyst is required downstream of the NO_x catalysts to remove remaining HC and aldehydes. At the same time, there is a narrow temperature range of NO_x conversion over the platinum, so that the cycle average NO_x conversion is highest when the three catalysts are used in combination.