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Development of Catalytically Selective Electrodes for NO_x and NH_3 Sensing

Background

Recent efforts to improve vehicle fuel economy as well as to reduce emissions have demonstrated the need for a NOx sensor. The NOx sensor is an enabling technology which will promote the advancement of both lean burn gasoline engines and diesel engines by permitting improved engine control along with mandated on-board diagnostics. In addition, NOx sensors are required for new NOx remediation techniques such as SCRs utilizing hydrocarbon (HC) injection and urea injection. The use of urea injection presents an interesting problem; the need for an ammonia sensor. These electrochemical sensors under development by the automotive suppliers are extremely complex devices. This high degree of complexity leads to durability issues as well as low-end sensitivity problems. There are also some problems of selectivity since these devices respond strongly to ammonia (urea) and can be affected by reducing species such as HCs. Some of these problems arise because of the high processing temperatures (> 1500C) required to fabricate the ceramic elements. These high temperatures limit the use of more selective electrode materials. To facilitate development of this sensor, new materials compatible with the base materials and processing temperatures need to be developed. The successful development of catalytically selective electrode materials can be used to develop sensors that are selective to an individual gas species and would allow the development of more simplistic NOx sensors. The difference in catalytic response between two different electrode materials exposed to the same gas mixture could provide a "differential electrode equilibria" (mixed potential sensor) that could be used to selectively measure NO_x.

The Technology

The proposed project seeks to develop a NOx sensor able to operate at 500°C or less with a fast response time to NOx. The research will focus on developing electrodes and catalysts for simple planar mixed potential sensors.

Benefits

- NOx sensors can be used for closed-loop control of emission control technologies and optimum engine operation
- Benchmark experiments have identified major technology barriers to NO_x sensors
- Ammonia sensors will allow the use of urea SCR reducing NOx emissions.

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