Development of a Selective Mixed-Potential Ammonia Sensor for Automotive Exhausts

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Abstract

One of the most effective technologies in decreasing large-scale NO_x emission produced by diesel engine vehicles is Urea-SCR (selective catalytic reduction) system. In order to prevent inducing excessive ammonia to the environment, an NH_3 sensor is required at the exit of this system [1, 2]. In this study, highly selective ammonia sensors were developed to detect ammonia emissions from automotive exhaust.

The sensors were fabricated with 8-YSZ electrolyte, a platinum reference electrode and a working electrode of Au-V_2O_5 (mass ratio 85/15), screen-printed on an alumina substrate. A platinum resistor was printed at the backside of the support to control the sensor temperature. The measured sensor' response (ΔV) is the potential difference between reference and working electrodes. Figure 1 shows the responses of two identical sensors to 100 ppm CO, NO_2, NO and 20 ppm of NH_3 at four different temperatures. It can be seen that the sensors respond to all gases at lower temperatures while by increasing temperature to 600°C, the selectivity to NH_3 is greatly improved. The selectivity of sensors was also confirmed by testing other possible interfering gases: no responses were observed for 20ppm of hydrogen and 100ppm of a hydrocarbon mixture.

The stability of such sensors was studied at 550°C and 600°C. Since the sensors show no long-term stability at 600°C (electrode degradation), but remain stable at 550 °C, investigations were made to decrease the working temperature while maintaining selectivity. After testing different mass percentages of V_2O_5 in working electrode, we observed that by increasing this value to 50%, the working temperature of selective ammonia sensors could be decreased to 550°C with stable responses.

Further investigations will be performed in order to gain deeper insight in sensing mechanism of V_2O_5 based working electrodes, which governs the sensor's performance.

References

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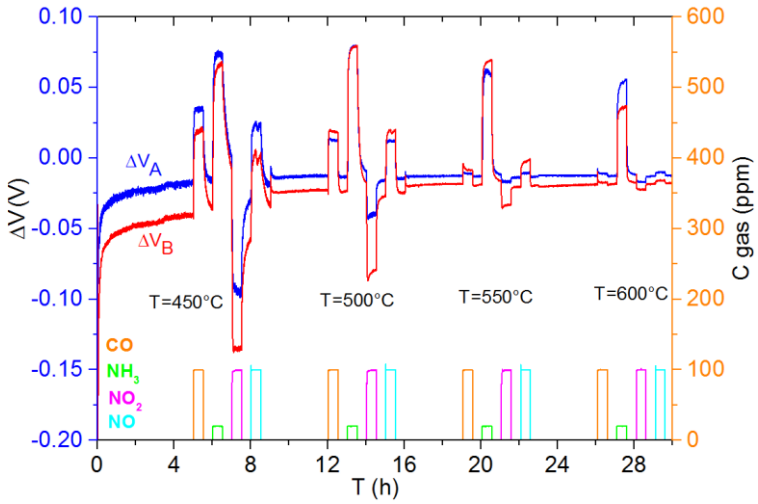

Figure 1 : Responses of Au-15%V_2O_5 electrode YSZ based sensors to CO, NH_3, NO_2 and NO at temperatures of 450, 500, 550 and 600°C.