Development of a sensitive and 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 supports. 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 and no responses were observed for 20ppm of H_2 and 100ppm of a hydrocarbon mixture.

The stability of such sensors was studied at 550 °C and 600 °C. Since sensors showed no long term stability at 600 °C (electrode degradation), but remain stable results at 550 °C, investigations were made to decrease the selective 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.

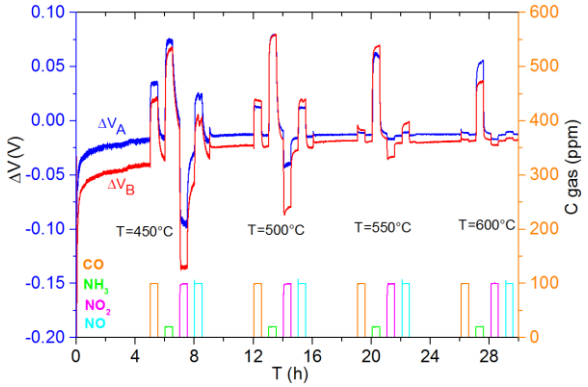

Figure 1: Responses of Au-15%V_2O_5 electrode YSZ-based sensors to CO, NH_3, NO_2 and NO at temperatures of 450, 500, 550 and 600°C.

References

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