

## Development of a NO<sub>x</sub> and NH<sub>3</sub> sensor for automotive exhaust applications and control of industrial process

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### Abstract

According to new European driving cycle, while the vehicular emissions of NO<sub>x</sub> and CO have decreased over the past years, ammonia emissions have considerably increased. Among all NO<sub>x</sub> reduction approaches that have been developed, selective catalyst reduction (SCR) system using ammonia as a reductant is one of the most reliable ways to control the NO<sub>x</sub> emissions from diesel engine vehicles and trucks. In order to optimize the conversion rates of NO<sub>x</sub> and to prevent inducing excessive NH<sub>3</sub> to the air, an NH<sub>3</sub> and NO<sub>x</sub> sensor is required to control the SCR system. Ivan Romanytsia et al. in 2015 have developed three-electrode mixed-potential selective NO<sub>2</sub> sensors. Based on this study, we aim to develop sensors for selective detection of both NO<sub>x</sub> and NH<sub>3</sub> for the exhaust of automotive. In this work, mixed potential gas sensors are fabricated by using two sensing materials of Au and Au-V<sub>2</sub>O<sub>5</sub> as working electrodes, YSZ as electrolyte and platinum as reference and counter electrode. In order to evaluate the performance of the fabricated planar sensors, the response to different pollutant gases such as CO, NH<sub>3</sub>, NO<sub>2</sub> and NO in respective amounts of 100, 20, 100 and 100 ppm are studied in a base gas composed of 12% O<sub>2</sub> and 1.5% H<sub>2</sub>O, balanced with N<sub>2</sub>. The sensor signal ( $\Delta V_{ref}$ ) is the difference of potential between the reference (Pt) and the working electrode. In order to take into account irreproducibility of the sensors due to fabrication process, all tests are reproduced with two sensors (A and B). Since NO<sub>2</sub> is an oxidizing gas, the galvanostatic mode can only produce the electro-chemical reduction of NO<sub>2</sub> at working electrode. Figure 1a shows the variations of the potential at 450 °C for different gases by applying a polarization current of 25nA from working to counter electrode. In these conditions, the responses to other interfering gases such as CO and NH<sub>3</sub> are removed while there is relatively a good selectivity towards NO<sub>2</sub>. Concerning ammonia gas sensors, Au-V<sub>2</sub>O<sub>5</sub> working electrodes displayed a high sensitivity to NH<sub>3</sub> as well as fast response and recovery times at 600 °C (figure 1b). In order to achieve an integrated NO<sub>x</sub> and ammonia sensor, which works simultaneously at the same temperature, further investigations are needed.

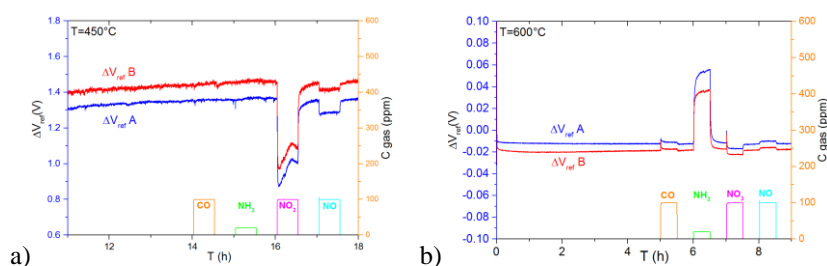


Figure 1. Response of the (a) Au sensors at 450°C with  $I=25$  nA and (b) Au-V<sub>2</sub>O<sub>5</sub> sensors at 600°C for pulses of CO (100 ppm), NH<sub>3</sub> (20 ppm), NO<sub>2</sub> (100 ppm) and NO (100 ppm) in base gas (12% O<sub>2</sub>, 1.5% H<sub>2</sub>O, balance N<sub>2</sub>).

### References

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