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

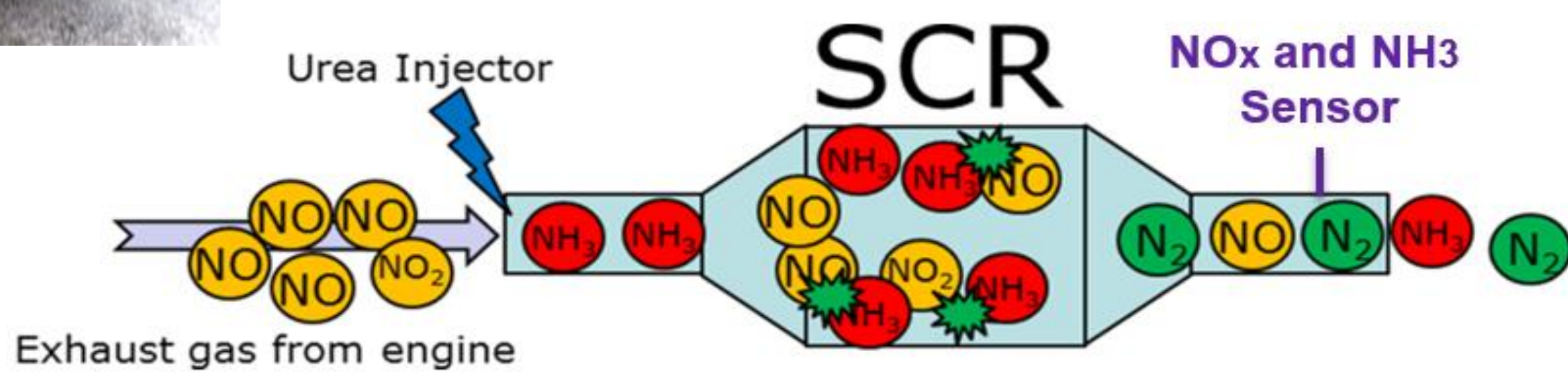
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## Introduction

**Air pollution** : Biggest concern of public and politicians  
Significant source of pollution are vehicles



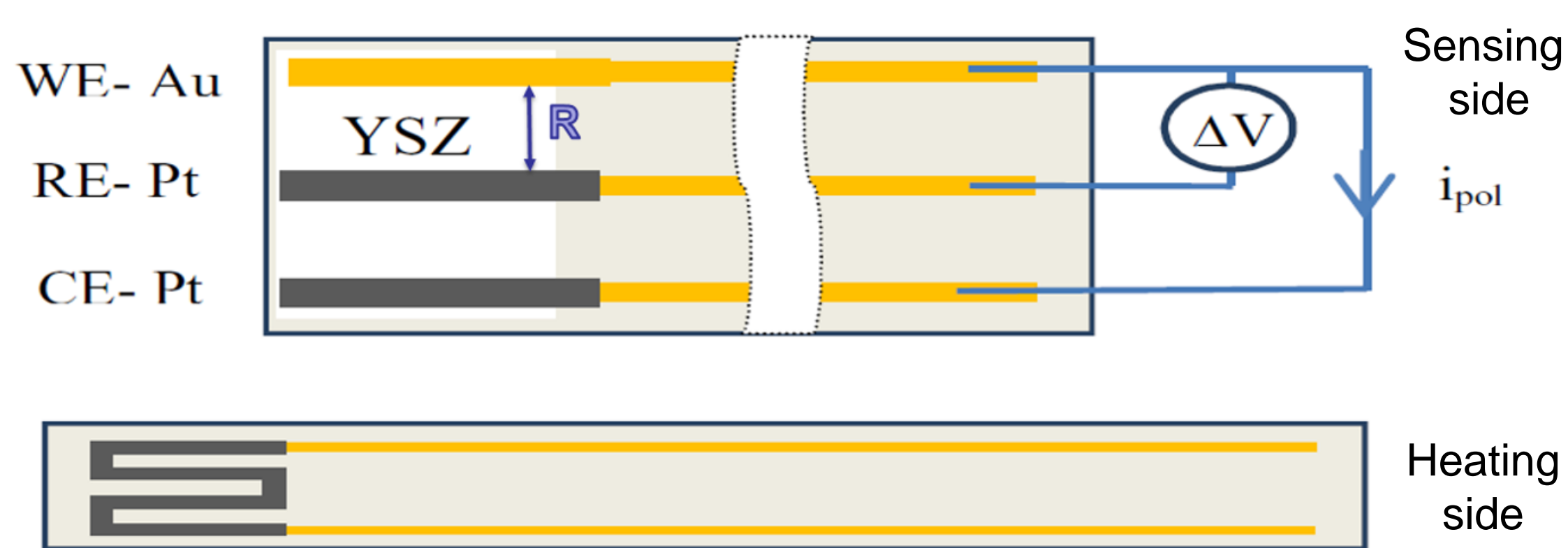
**Catalytic Reduction system (SCR)**  
Most effective NO<sub>x</sub> emissions control technologies in diesel vehicles



## Objectives

- Chemical NO<sub>x</sub> sensor integrated with measurement of O<sub>2</sub> and NH<sub>3</sub>
- Sensor capable of working in harsh environments

## Working principle



$$\Delta V_{ref} = E_0 + R(YSZ + Au + Pt)i_{pol} + \eta_{WE} + \eta_{RE}$$

### Sensor response

$$\Delta V_{ref} = V_{RE}(Pt) - V_{WE}(Au)$$

$R$  = Resistance (Ohmic drop)

$E_0$  = Potential when  $i_{pol} = 0$

$\eta_{WE}, \eta_{RE}$  = Over potential of working and reference electrode

$\eta_{RE} = 0$

Romanytsia, I.; Viricelle, J.P.; Vernoux Ph. and Pijolat C. Application of advanced morphology AuX (X=YSZ, ZrO<sub>2</sub>) composites as sensing electrode for solid state mixed-potential exhaust NO<sub>x</sub> sensor. Sensors and Actuators B: Chemical 2015, 207, 391-397]

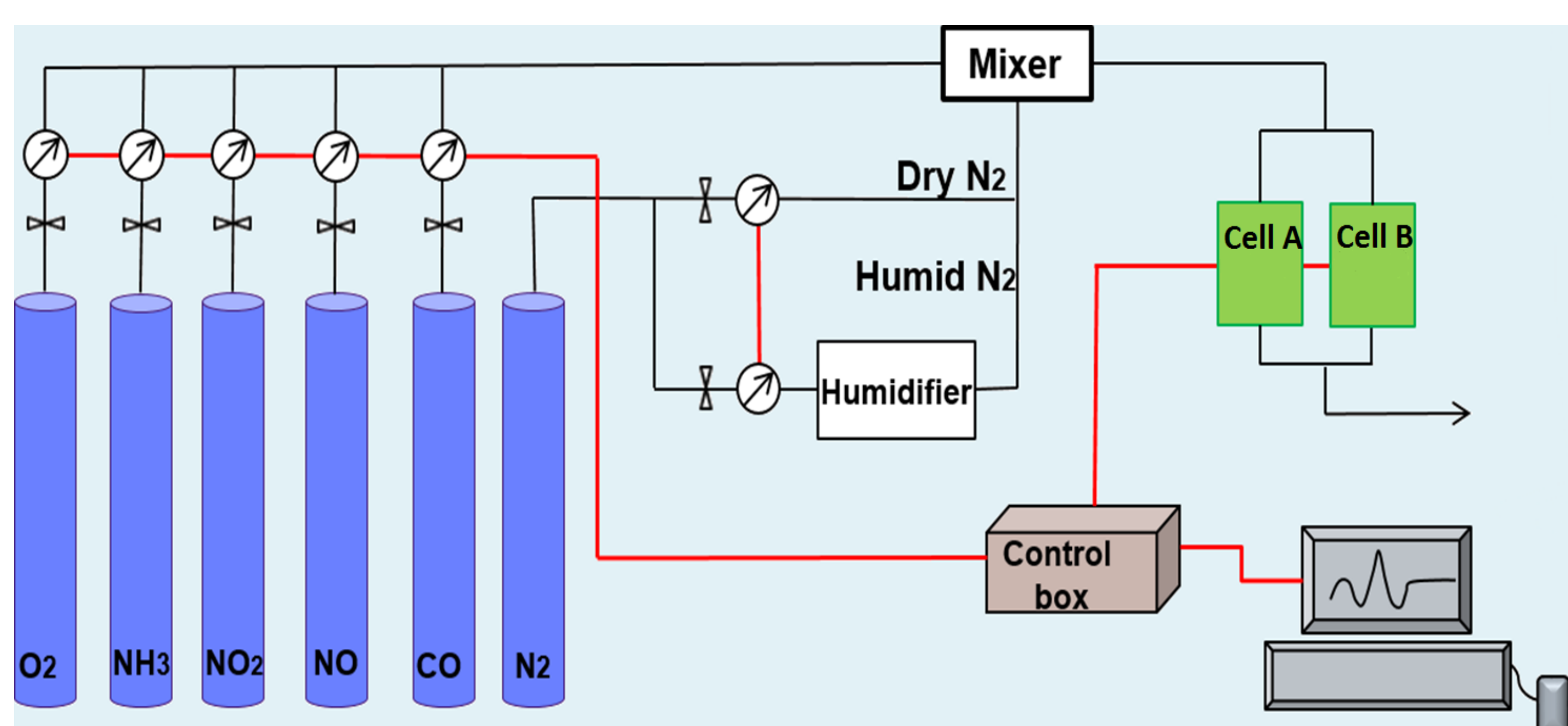
Viricelle J-P.; Vernoux Ph.; Gao J.; Romanytsia, I.; Breuil P.; Pijolat C. NO<sub>2</sub>-selective electrochemical sensors for diesel exhausts. Procedia Engineering 2016, 168, 7-10]

## Experimental part

### Fabrication of sensors by screen-printing:

Two types of sensors with working electrode of Au or Au-V<sub>2</sub>O<sub>5</sub> using commercial and home-made inks.

### Test bench



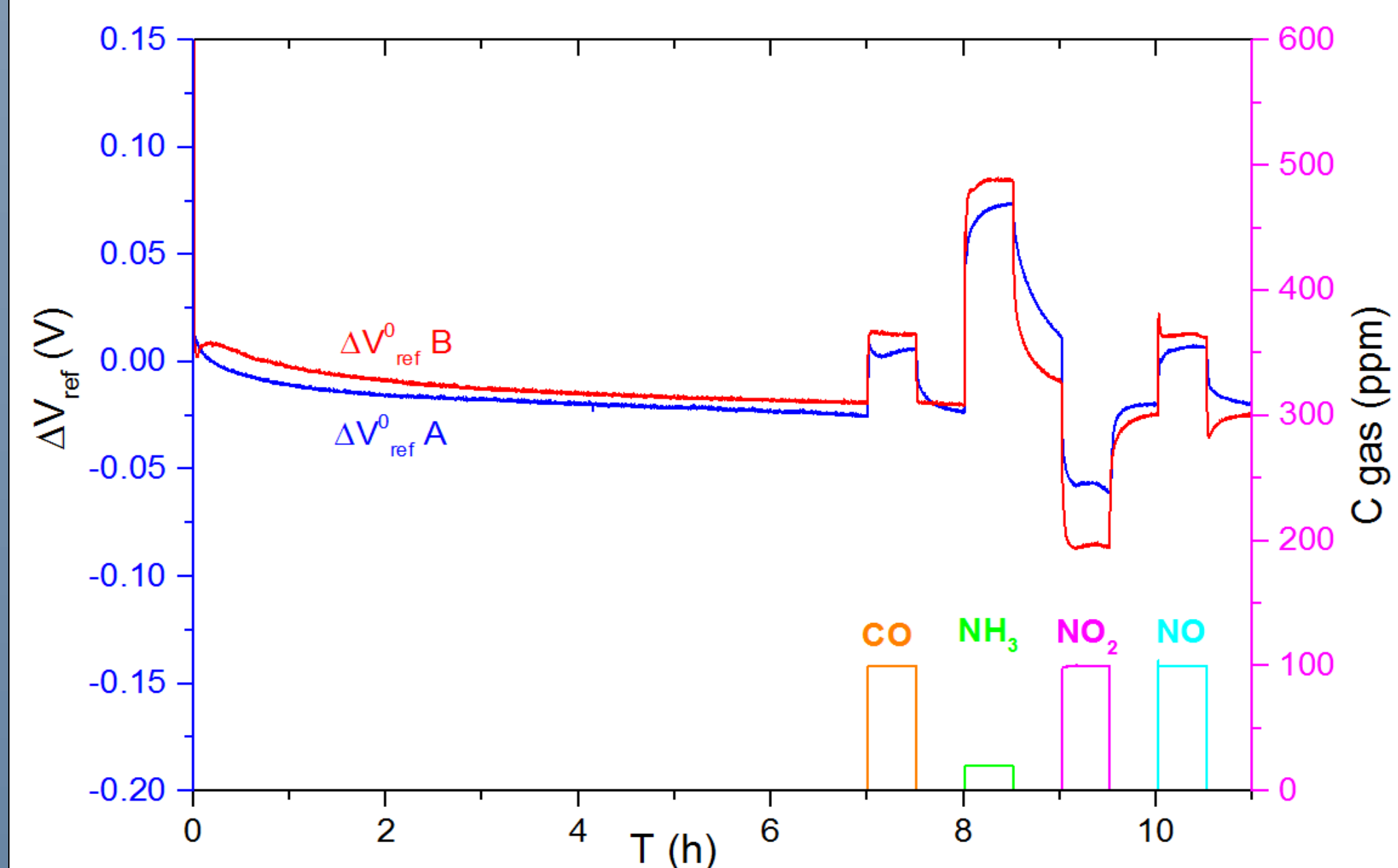
## Results

Response of sensors are for pulses of 100 ppm CO, 20 ppm NH<sub>3</sub>, 100 ppm NO<sub>2</sub> and 100 ppm NO in the base gas.

Base gas: 12% O<sub>2</sub> and 1.5 % H<sub>2</sub>O balanced with N<sub>2</sub>.

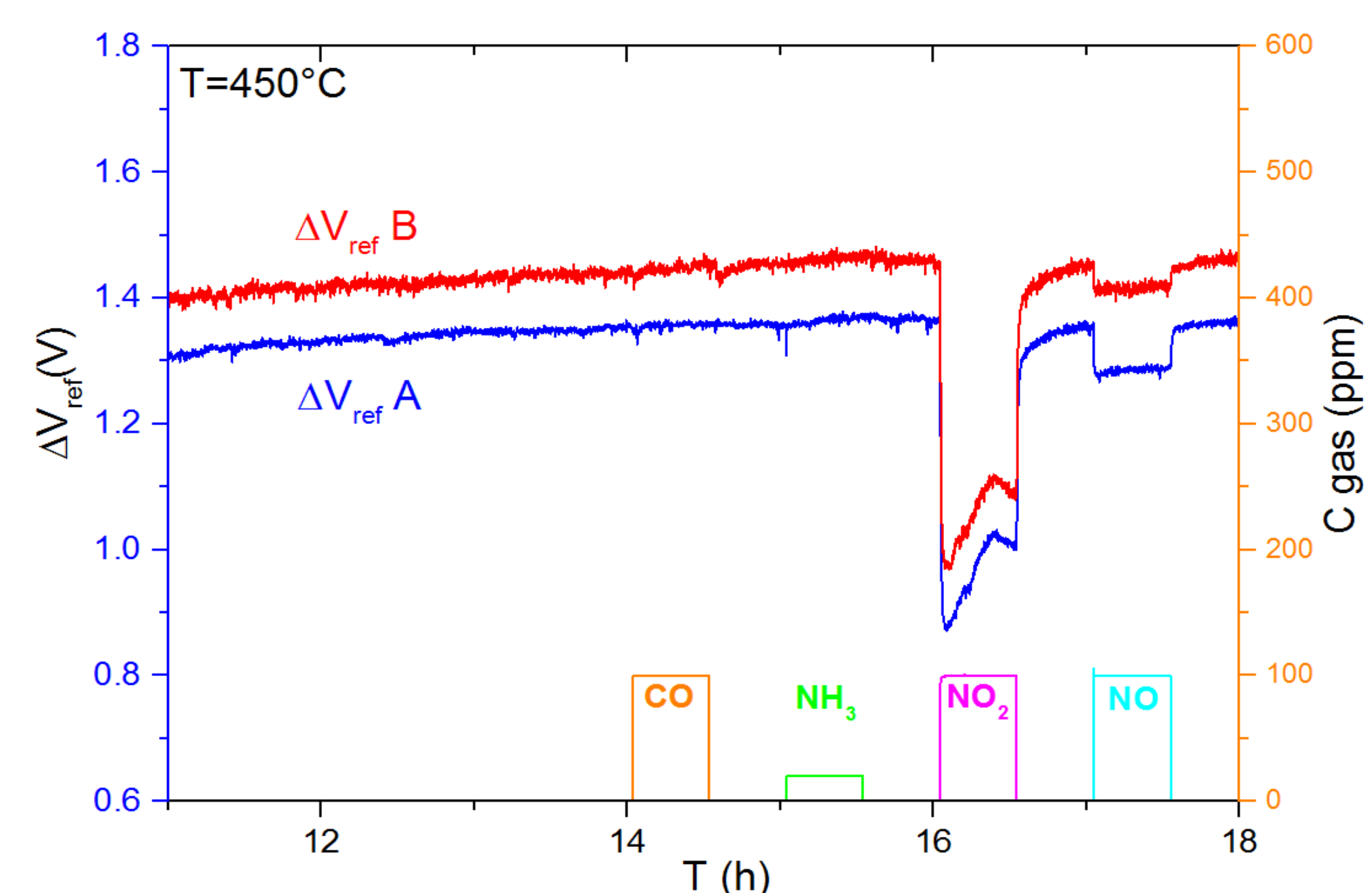
### Responses of Au(WE) sensors at 450°C

#### No current of polarization



- ✓ Positive response for reducing gas (CO, NH<sub>3</sub>, NO)
- ✓ Negative response for oxidizing gas NO<sub>2</sub>.

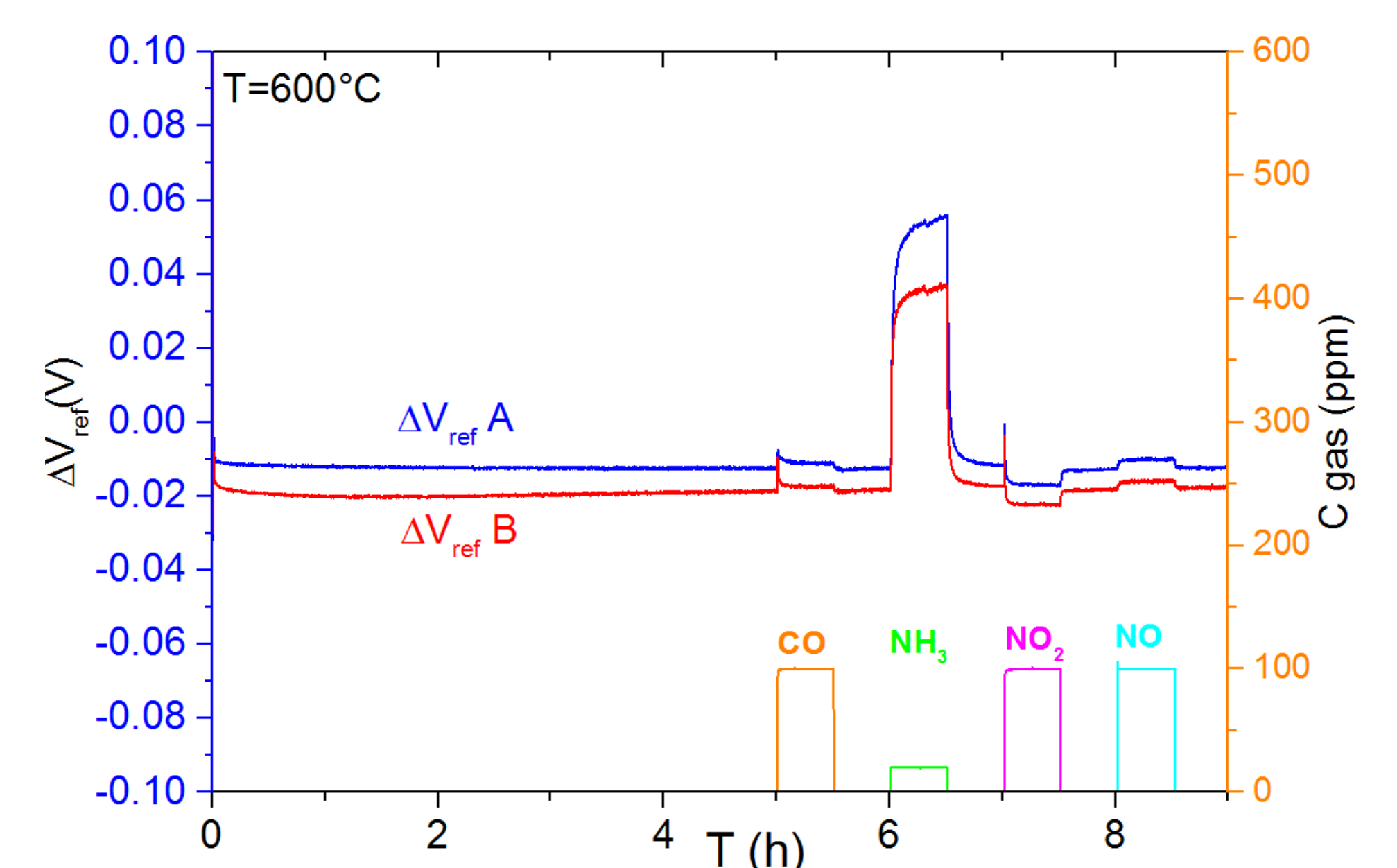
#### Polarization current of 25 nA



- ✓ Responses of interfering gases such as CO and NH<sub>3</sub> removed.
- ✓ Good selectivity towards NO<sub>2</sub>.

### Response of Au-V<sub>2</sub>O<sub>5</sub> (WE) sensors at 600°C

#### No current of polarization



- ✓ Selective to NH<sub>3</sub>
- ✓ Good sensitivity to NH<sub>3</sub>
- ✓ Fast response and recovery times

## Conclusion

- For Au sensors, by applying a polarization current of 25 nA at 450 °C a relatively selective response to NO<sub>2</sub> gas is achieved.
- 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.
- Further investigations are needed in order to reach an integrated NO<sub>x</sub> and NH<sub>3</sub> sensor, which works simultaneously at the same temperature.