

Study of YSZ electrolyte inks for preparation of screen-printed mixed-potential sensors for selective detection of NO_x and NH₃

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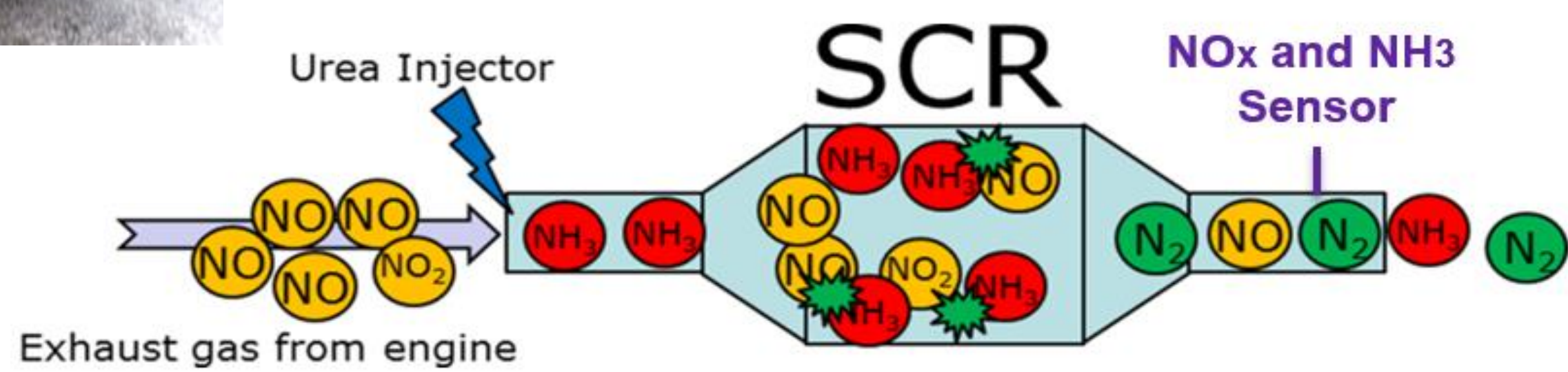
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Introduction

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



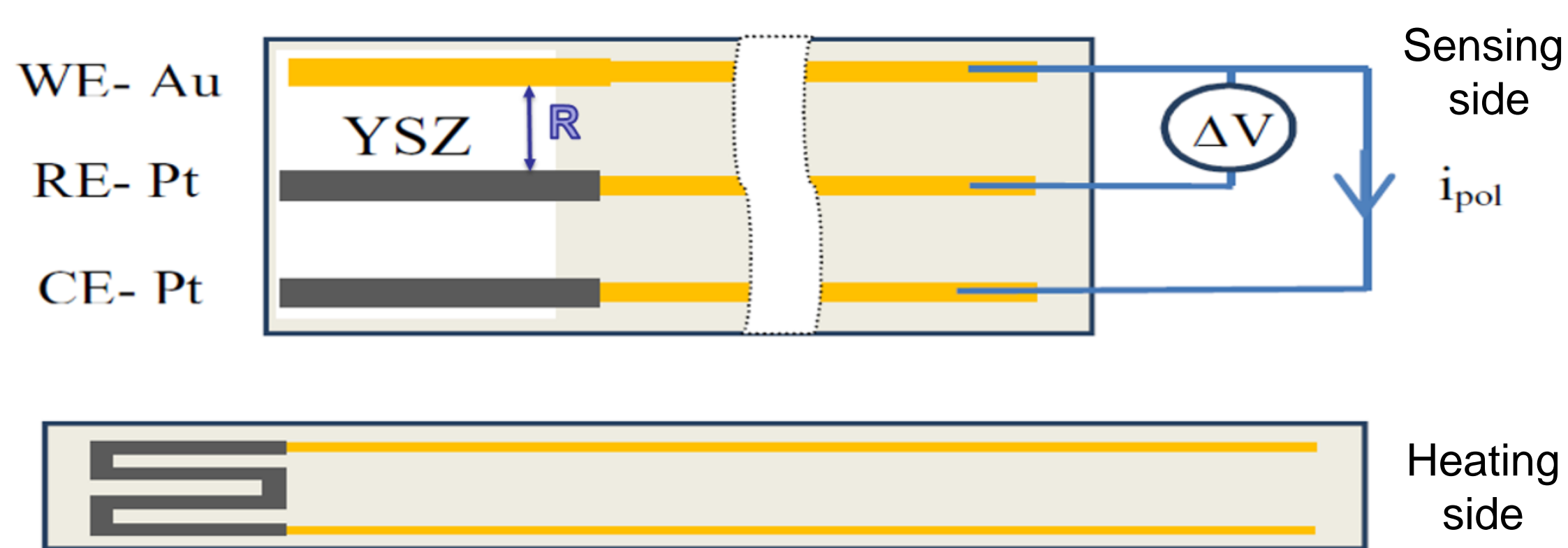
Catalytic Reduction system (SCR)
Most effective NO_x emissions control technologies in diesel vehicles



Objectives

- Chemical NO_x sensor integrated with measurement of O₂ and NH₃
- Sensor capable of working in harsh environments

Working principle



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

Sensor response

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

η_{WE}, η_{RE} = Over potential of working and reference electrode

R = Resistance (Ohmic drop)

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

$\eta_{RE} = 0$

[Romanytsia, I.; Viricelle, J.P.; Vernoux Ph. and Pijolat C. Application of advanced morphology AuX (X=YSZ, ZrO₂) composites as sensing electrode for solid state mixed-potential exhaust NO_x sensor. Sensors and Actuators B: Chemical 2015, 207, 391-397]

Viricelle J-P.; Vernoux Ph.; Gao J.; Romanytsia, I.; Breuil P.; Pijolat C. NO₂-selective electrochemical sensors for diesel exhausts. Procedia Engineering 2016, 168, 7-10]

Experimental part

Fabrication of sensors by screen-printing with different YSZ solid electrolyte :

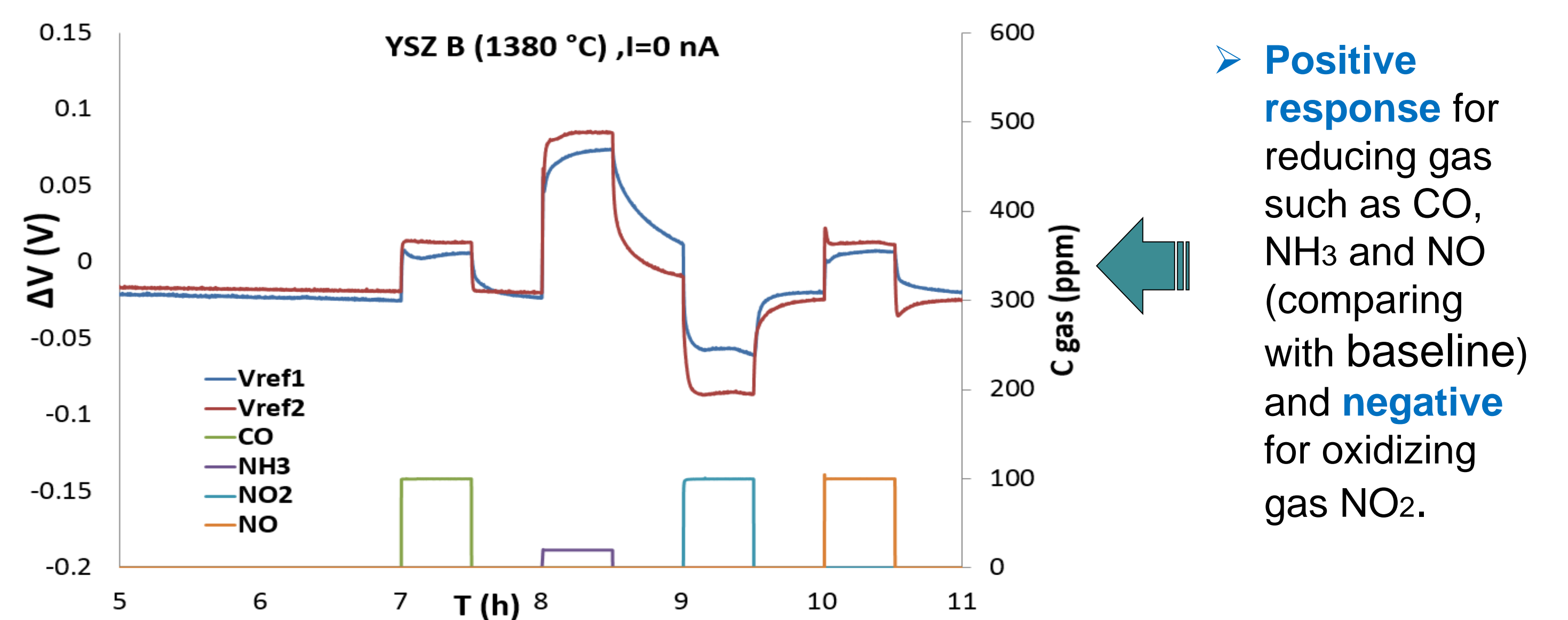
- Commercial YSZ ink (named A) sintered at 1380°C
- Commercial YSZ ink (named A) sintered at 1480°C
- Home-made ink using YSZ powder (named B) sintered at 1380°C.

Test bench



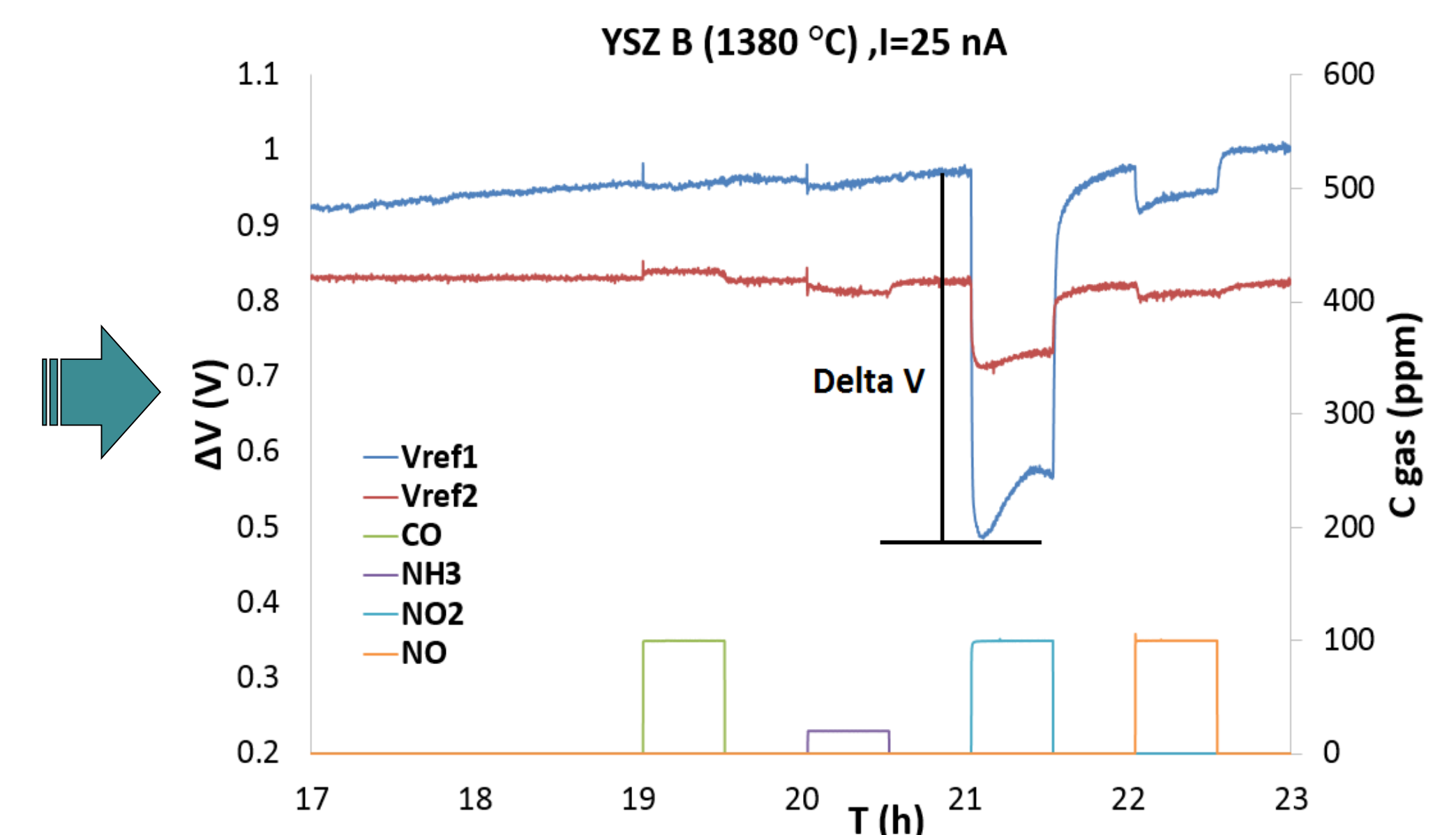
Results

Reproducibility tests and working principles:

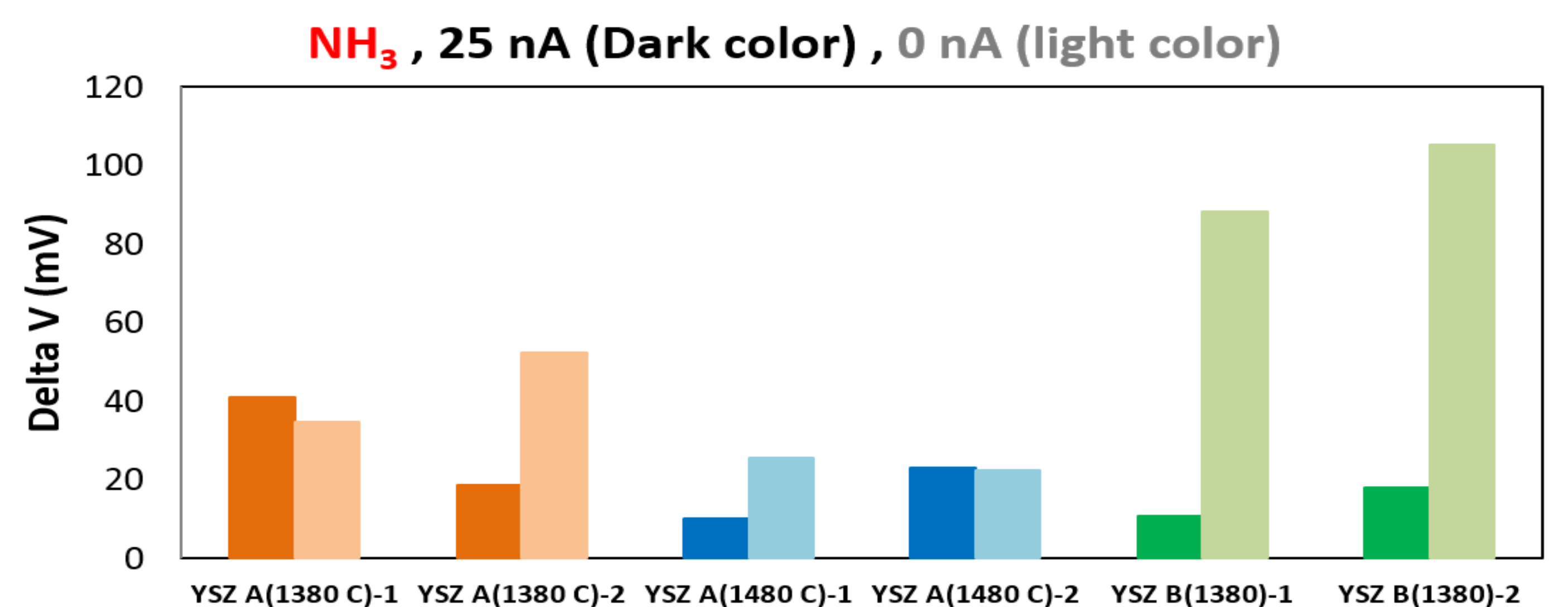


➤ **Applying a polarization current** of 25 nA:

- ✓ Responses of interfering gases such as CO and NH₃ removed.
- ✓ Good selectivity towards NO₂.

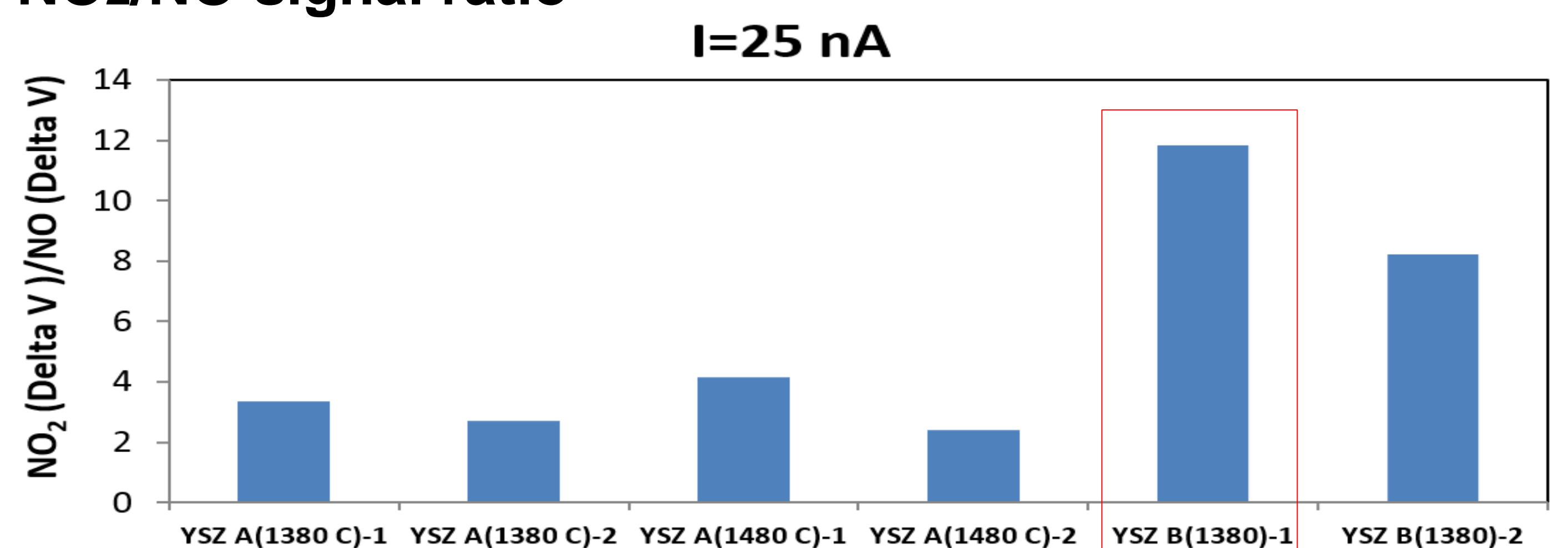


NH₃ response



Sensors with YSZ B: More significant responses toward NH₃.

NO₂/NO signal ratio



Sensors with YSZ B: Higher NO₂/NO signal ratio

Conclusion

➤ Sensors made with home-made ink B: highest responses towards NO_x and ammonia gases.

➤ Further investigations on chemical composition of YSZ inks and microstructure of electrolyte film to explain these responses.

