

# Indirect Sensing techniques for performance based verification

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- Summary

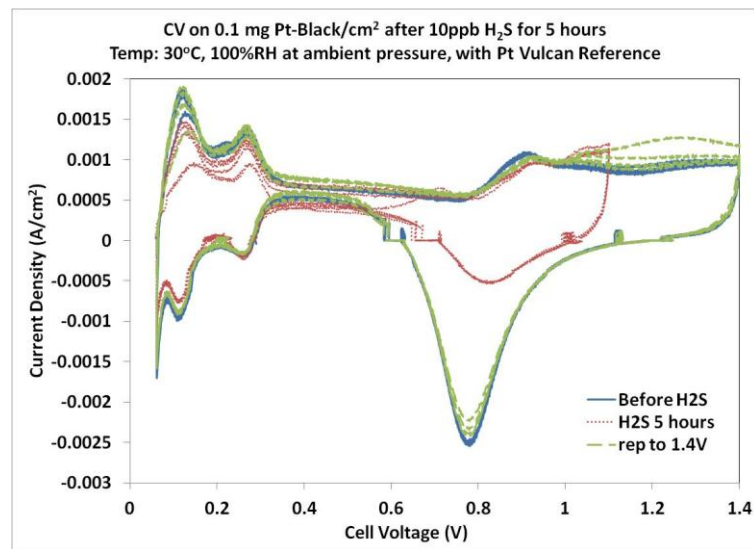
# Concept

**Inline hydrogen analyzer to continuously monitor** impurities and alert the user to any fuel quality issues, **both on-board in the fuel stream and at the nozzle.**

Concept: Use a fuel cell type device to measure impurities in the fuel stream.

The device should be:

- Sensitive to the same impurities that would poison a fuel cell stack
  - Use same components (Nafion<sup>®</sup>, Pt and C) as the fuel cell stack
- Orders of magnitude more sensitive to impurities than the fuel cell stack
  - Use extremely low Pt loading and low surface areas
- Durable and low cost
  - Use small area cells, large Pt particle sizes (eliminate carbon), and thick electrolytes



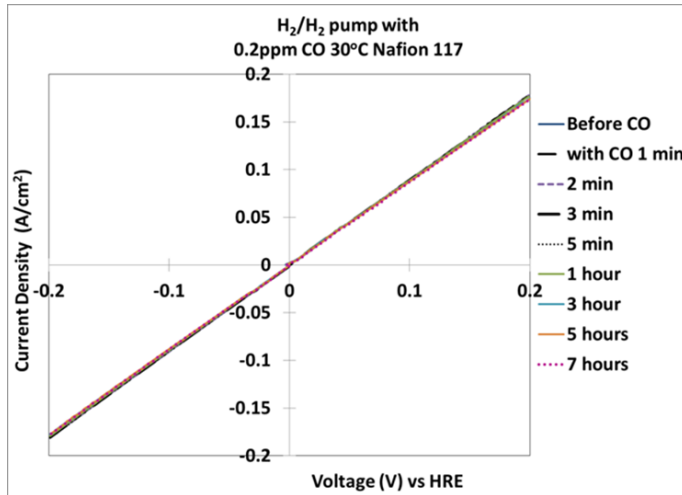
# Advantages / Dis-advantages

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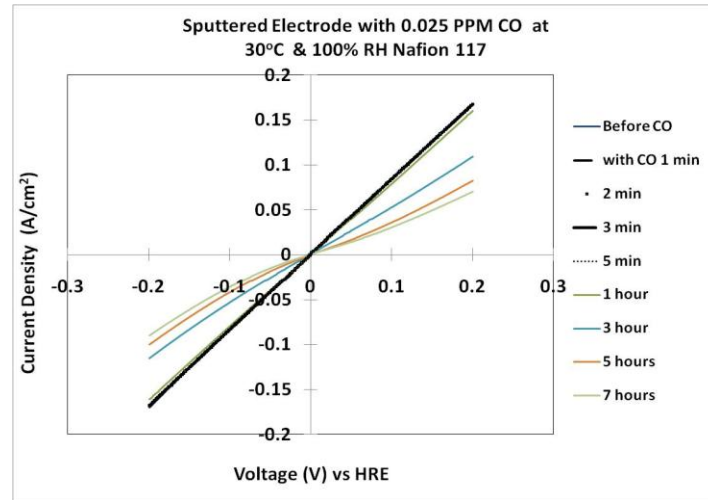
- Sensitive to any impurity that has the ability to poison fuel cells
- Low cost technology that has the ability to quickly alert user to any potential fuel quality issues
- Ability to be adapted to fuel station or to on-board applications
- Potential ability to distinguish between classes of impurities (eg. CO and H<sub>2</sub>S)
- Compatible with impurity concentration systems
  - H<sub>2</sub> permeable membranes to concentrate impurities
  - Pressure swing adsorption cycles to adsorb and concentrate impurities
  
- Difficult to use this technology to quantitatively certify impurity concentration
- Maintain membrane water content
- Drift over time (may require recalibration)
- Lack of a clean reference electrode

# Current Status

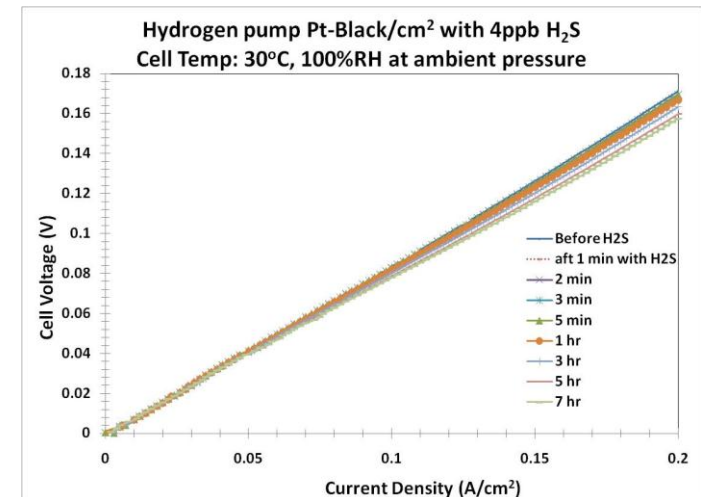
## Pt/Ru Electrode



## Pt sputtered electrode



- ✓ Demonstrated sensitivity to 25 ppb CO and < 5 ppb H<sub>2</sub>S in a H<sub>2</sub> pumping cell
- ✓ The decrease in current is proportional to the poisoning dosage
- ✓ Demonstrated that potential can be used to impart selectivity (CO vs H<sub>2</sub>S) to the analyzer
- ✓ Demonstrated that electrode composition can be tuned to adjust sensitivity and selectivity



# Summary

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- Proof of concept of H<sub>2</sub> in-line fuel quality analyzer demonstrated at LANL
- CO and H<sub>2</sub>S sensitivity demonstrated at relevant concentrations and times.
- Engineering hurdles need to be overcome for this proof of concept to be transitioned into a practical device
- Timeframe (2 years to prototype development)