**Novel Sulfur-Tolerant Catalysts and Desulfurizers for Jet Fuel Reforming**

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**INTRODUCTION**

NASA envisions employing fuel cells running on jet fuel reformate for its unmanned aerial vehicles (UAVs), low emission alternative power (LEAP) missions and for transatlantic and intercontinental commercial flights. The catalysts used for reforming gasoline and natural gas are severely poisoned by the sulfur present in jet (JP-8, Jet-A, etc.) fuels. If left unattended, it leads to the formation of H2S which is detrimental to the anode in the fuel cell stack in addition to emitting unpleasant odor. The currently used catalysts deactivate quickly and/or are poisoned due to large sulfur contents in the simulated surrogate fuels. Development of new sulfur-tolerant reforming catalysts and robust desulfurizers is a critical path in the designing of jet fuel processors and their eventual utilization in powering NASA’s research and commercial flights using solid oxide fuel cells.

**OBJECTIVES**

- Designing nanoscale ceria-based sulfur-tolerant reforming catalysts with low loading of the noble metals.
- Designing sulfur sorbent with S-binding species localized in highly periodic nanopores.
- Characterization with regard to crystallographic, morphological/microstructural features and noble metal dispersion.
- Evaluation with regard to sulfur capture, poisoning and regeneration behavior.

**EXPERIMENTAL DETAILS**

**Materials**

- Nanoscale doped ceria supports
- Noble metal precursors
- Appropriate oxide additives
- Highly ordered nanoporous sorbent support

**Fuel reforming protocol**

- Fuel: Toluene (Jet fuel surrogate)
- Temperature: 450-825°C
- Duration: 4-24 h
- Parameters: T = 825°C, P = 1 atm, Steam to Carbon (S/C) ratio = \( \frac{3}{3} \)

**Desulfurization protocol**

- Temperature: 450-825°C
- Duration: 0.24 h
- Ambient: 1000 ppm H2S in H2

**Characterization**

- TPR, XRD
- SEM/EDS, RBSE
- TEM/SAED, XPS

**RESULTS AND DISCUSSION**

**CONCLUSIONS**

- Novel sulfur-tolerant nanocatalysts for jet fuel reforming have been developed.
- Bi-metallic formulations surpassed the single-metal performance in terms of hydrogen yield and stability.
- Metal oxide additives provide beneficial catalytic effects and better sulfur tolerance.
- Naturally occurring lightweight, biomimetic nanoporous structures provide effective sulfur scavenging.

Acknowledgments: NASA Glenn Research Center (Grant NNC04GB44G) + College of Engineering + Prof. Martin Abraham