Design and Fabrication of Novel Mixed Ion-Electron Conducting Membranes for Oxygen Separation

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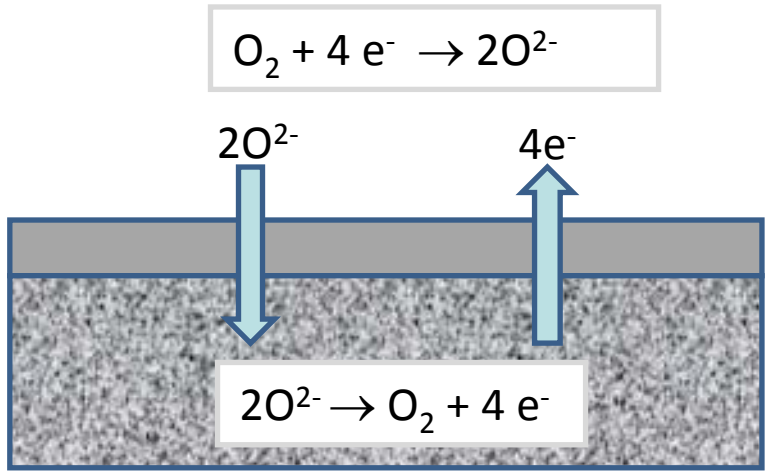


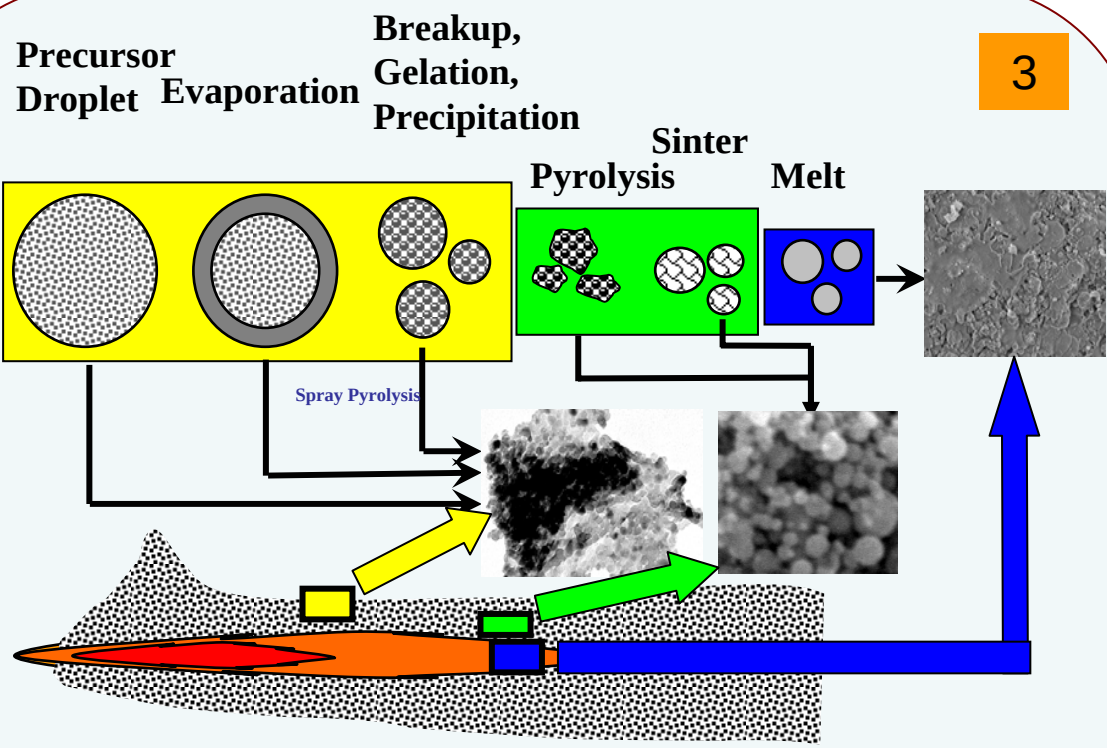
The Challenge/Opportunity

- **On-site oxygen production for coal gasification represents 12 – 15% of the installed capital costs. Cryogenic plants are the dominant technology** 1
- **Ion-Electron Mixed Conductors (IEMC) have significant cost and energy savings**

Project Objective and Benefits

- **Demonstrate improvements in the manufacturing process for thin membranes (<10 micron) through advancements in SPPS technology**
- **Develop a novel perovskite IEMC membrane material with improved ionic conductivity and surface kinetics**

The Solution Precursor Plasma Spray (SPPS) Process



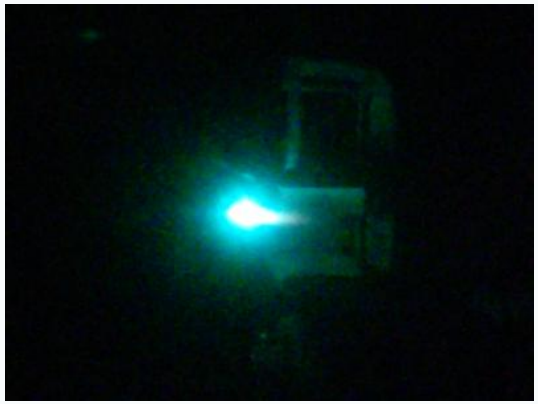
- Dense to porous microstructure
- Varied nano/micro-scale microstructure
- Splat diameter < 2 μm, Splat area is 1/2500 of that in traditional plasma spray

New IEMC Candidate Materials

Novel perovskite Compositions:

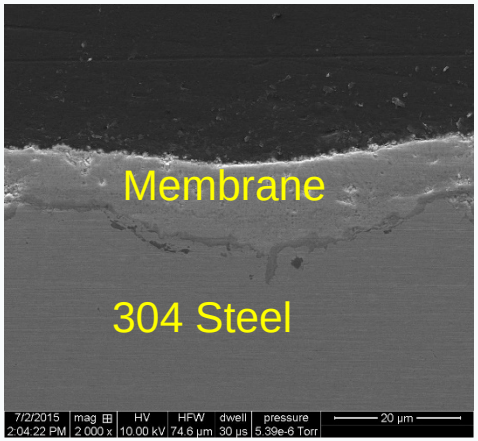
1. Higher oxygen ion diffusion
2. Faster surface oxygen exchange
3. Higher electrical conductivity
4. Materials composition validated in other solid state electrochemical applications

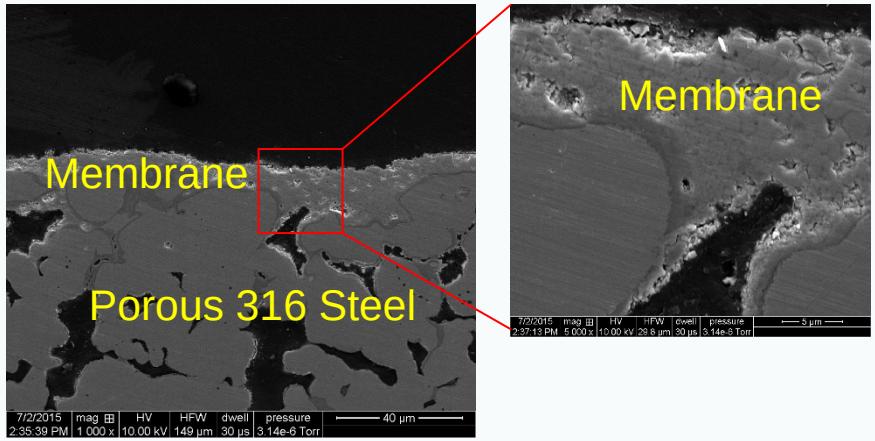
SPPS IEMC Thin Dense Membrane



Plasma Spray of persovskite with 9MB gun

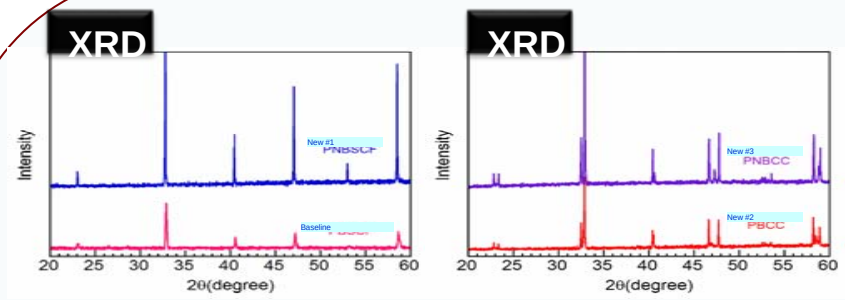
As-sprayed perovskite coatings



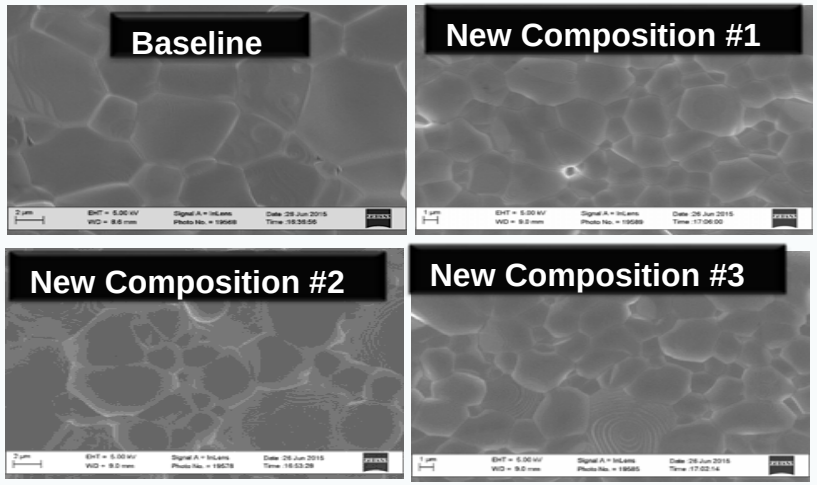


Dense novel perovskite coating with thickness ~ 10 µ m was successfully deposited on 304 stainless steel and porous 316 stainless steel.

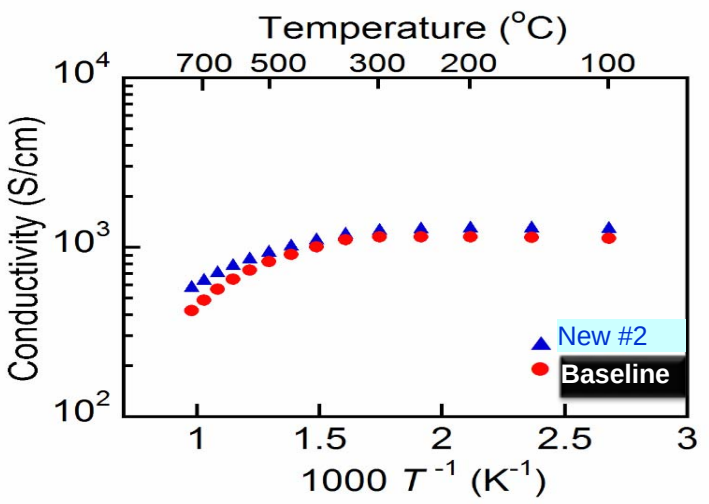
New Perovskite Materials Developed



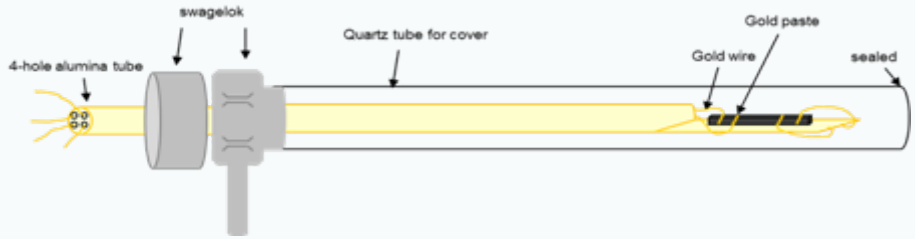
Results: SEM



Electrical conductivity in air



Setup for Electrical conductivity relaxation



- The electrical conductivities of all samples are measured at 700°C to 100°C

New perovskite material developed has 50% increase in electrical conductivity at 700°C, in comparison with state of art material.

Summary

- **Novel materials with enhanced electrical conductivity developed.**
- **Dense thin IEMC membranes were successfully deposited by solution precursor plasma spray (SPPS) process.**
- **Oxygen permeation tests of the new perovskite materials and SPPS IEMC membranes will be performed at HiFunda LLC.**