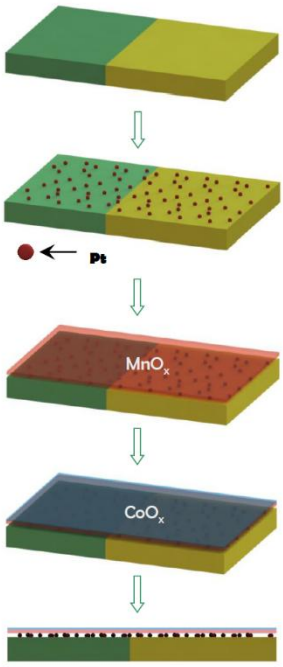
TECHBRIEF

NETL Ref. No: 18N-25

ALD-Formed Multilayer Electrocatalyst Structures



Schematic of ALD deposition procedure

Opportunity

Improving the activity and durability of solid oxide fuel cell (SOFC) electrodes requires electrocatalyst architectures that remain nanoscale, uniformly distributed and resistant to coarsening under high-temperature operation. Researchers at the U.S. Department of Energy's National Energy Technology Laboratory (NETL) and West Virginia University (WVU) established an atomic layer deposition (ALD) method that forms a controlled multilayer electrocatalyst structure directly on porous electrode backbones. The process begins with an ALD layer of discrete nanoparticles of the first electrocatalyst, followed by one or more ALD layers containing the second electrocatalyst. These stacked layers create a composite nanostructure that stabilizes catalyst particle size and increases active site density during oxygen reduction. Because ALD provides conformal coating throughout the porous network, electrocatalyst loading can be minimized while preserving accessibility to gas pathways and ionic transport. The resulting electrodes maintain performance at temperatures above 650°C, where conventional infiltrated catalysts typically agglomerate. This technology is available for licensing and/or further collaborative research from NETL in collaboration with WVU.

Problems Addressed

- SOFCs are significantly limited by the performance of their porous cathodes, where the oxygen reduction reaction dominates device efficiency.
- Traditional chemical solution-based infiltration methods face substantial challenges in depositing uniform films onto the complex, three-dimensional porous structures of cathodes.

Potential Commercial Application

- Manufacturing of Advanced SOFCs: enables the production of SOFCs with significantly higher power density, improved durability and the potential for lower operating temperatures.

Competitive Advantages

- Enhanced Uniformity and Conformality: ALD provides highly uniform and conformal coatings on complex 3D porous structures, ensuring consistent catalyst distribution throughout the cathode.
- Improved Catalyst Stability: ALD-deposited nanostructured coatings exhibit enhanced thermal and chemical stability, reducing degradation over time.
- Scalability and Process Efficiency: The ALD process is automated, time-efficient, scalable and capable of processing multiple SOFCs simultaneously.

Intellectual Property Status

A U.S. patent (US11316169) was issued on April 26, 2022, and expires on March 11, 2040.

Publications

X. Song, et al. Methods for forming electrocatalyst structures and electrodes comprising same. (2022). United States Patent and Trademark Office. U.S. Patent No.: 11,316,169.

Licensing

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