Solid Oxide Cell Short-Stack Kit

Fuel Cell Materials is the commercial product brand of Nexceris. All products discussed in this whitepaper are available at **fuelcell**materials.com

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1. Introduction

The development of Solid Oxide Fuel Cells (SOFCs) and Solid Oxide Electrolyzer Cells (SOECs) is critical for advancing sustainable energy systems, but researchers face significant challenges in validating cell innovations at large-format cell and stack-level scales. This bottleneck hinders the progress of materials innovations, ultimately slowing the commercialization of these technologies. Nexceris, a pioneer in solid oxide cell technology development, has identified this challenge as a key opportunity to provide a versatile short-stack solution (Figure 1), built on its *NextCell*™ cell platform that accelerates research in SOFCs and SOECs.

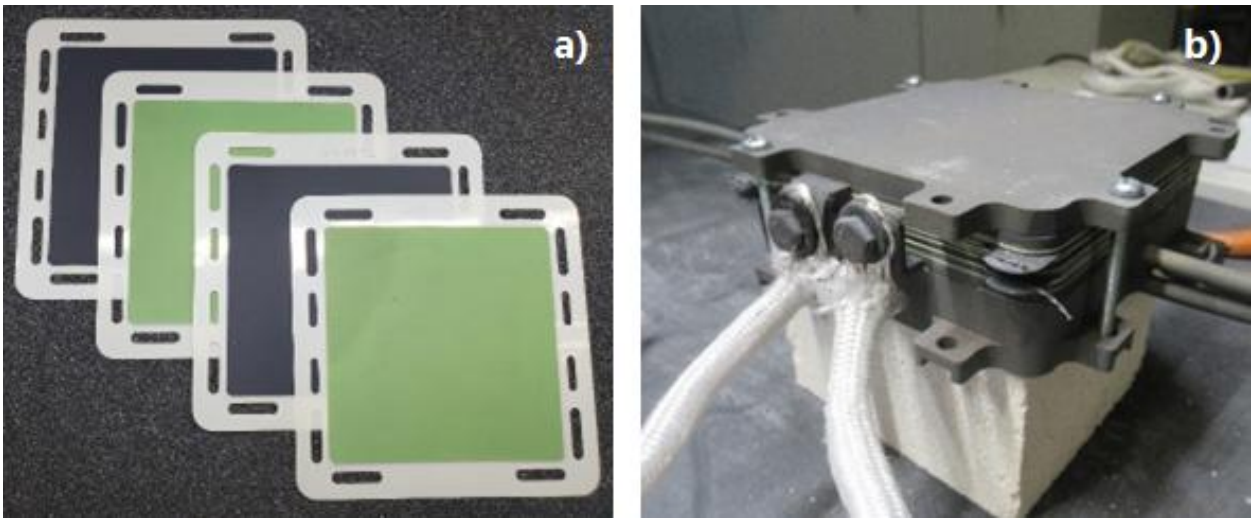

Figure 1. Nexceris' ported *NextCell*™ (81 cm^2 active area) cell platform (a), 5-cell short-stack kit.

The lack of access to specialized equipment and facilities, difficulty in replicating results consistently, and collaboration and communication barriers are among the pain points that SOFC/SOEC Researchers face when developing innovative materials solutions. These challenges not only impede the development of new materials but also hinder the ability to validate these innovations at the large cell and stack level, ultimately limiting the potential for industry partnerships and commercialization.

Nexceris, with its 30 years of experience and commitment to research and development, is well-positioned to address these challenges. The company's expertise in materials innovations, advanced testing and validation capabilities, and customized solutions for research needs make it an ideal partner for researchers. The introduction of the Nexceris Short-Stack kit represents a significant step forward in addressing the challenges faced by SOFC/SOEC researchers. By providing a novel solution for validating cell innovations at the short stack scale, the kit has the potential to accelerate the development of sustainable energy systems, enabling the creation of more efficient, reliable, and cost-effective SOFCs and SOECs.

This whitepaper will provide an overview of the Nexceris Short-Stack kit, its key benefits, and how it addresses the needs of SOFC/SOEC Researchers, highlighting the value proposition of this innovative solution for the advancement of sustainable energy systems.

2. Key Benefits

The Short-Stack kit enables researchers to quickly prototype, test, and scale new materials sets or designs, accelerating the development of SOFC and SOEC technologies. The Nexceris Short-Stack kit provides several key benefits to customers including:

- Improved Cell Reproducibility: The Short-Stack kit uses Nexceris' *NextCell*™ cell platform. This ensures consistent and reliable results, addressing the challenge of replicating results. Cell results can be readily transitioned to short-stack results.
- Access to Specialized Expertise: With Nexceris' 30 years of experience and expertise in materials innovations, customers gain access to valuable knowledge and support, enhancing their research capabilities.
- Customized Solutions: The kit's modular design enables short-stack testing of 1-5 cells.
- Increased Efficiency and Productivity: The kit's compact design, novel manifold design, and quick reversible operation enable researchers to test and validate new materials and designs rapidly, reducing the time and resources required for research and development.

3. Design

The Nexceris Short-Stack kit features several key components that enable advanced testing and validation capabilities. The key features of the kit include:

- Novel Manifold Design: A unique manifold design that enables quick prototyping, testing, and scaling of new materials sets or designs.
- Ceramic Composite Fuel and Air Seals: Advanced seals that provide excellent performance and durability in high-temperature ceramic electrochemical systems.
- Compact Stack Design: A compact design (footprint of 140 mm x 140 mm) makes the kit compatible with many commercially available testing furnaces and enables researchers to easily integrate the kit within their existing facilities.
- Ferritic Interconnects with Protective Coatings: High-temperature manganese cobalt oxide $(Mn,Co)_3O_4$ coatings provide excellent electronic conductivity and low Cr diffusion, making them ideal for use in SOFC and SOEC applications.

- Quick Reversible Operation: The short-stack kit can switch between SOFC and SOEC modes in under 15 minutes, enabling researchers to quickly test and validate cell innovations in both fuel cell and electrolysis modes.

4. Performance

The Short-Stack kit demonstrates excellent performance in both fuel cell and electrolysis modes (Figure **2**). Key performance results include achieving a current density of 0.43 A/cm^2 at 0.7 V/cell in fuel cell mode and a current density of 0.6 A/cm^2 at 1.35 V/cell in electrolysis mode.

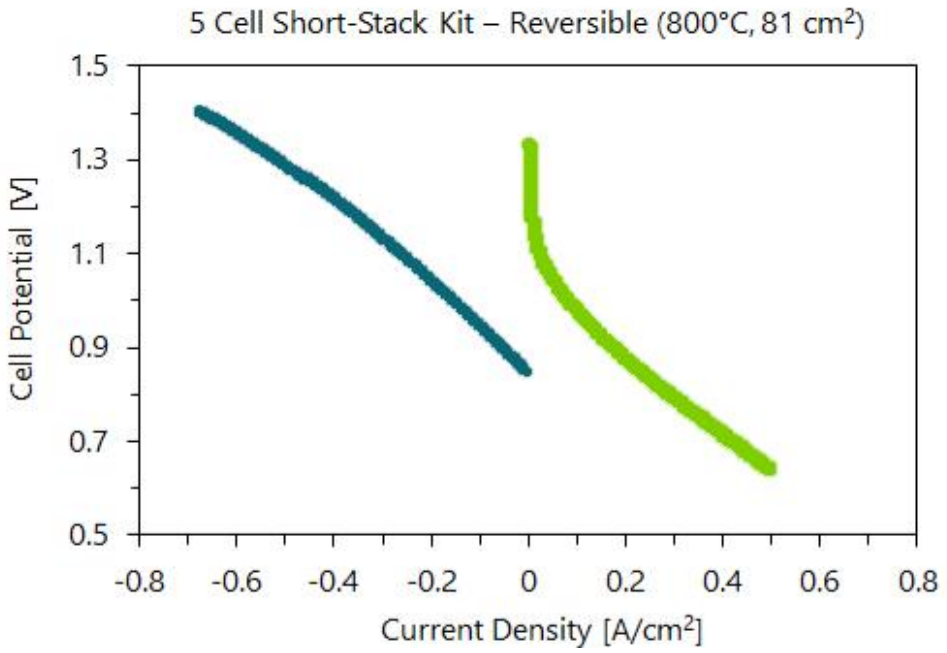

Figure 2. 5-cell Polarization curves in SOEC (in red, H_2O/H_2 - 90/10, 50% utilization) and SOFC (in blue H_2O/H_2 - 50/50, 50% utilization) conditions at 800 °C.

5. Conclusions

Nexceris Short-Stack kit is an exciting new product designed to accelerate SOFC/SOEC research. This Short-Stack kit addresses significant bottlenecks in the development of these technologies by providing a versatile solution for validating cell innovations at the short-stack scale.

To learn more about the Nexceris Short-Stack kit and how it can accelerate your research please contact Nexceris. Our team of experts is available to provide additional information, answer questions, and discuss how the kit can be tailored to meet your specific needs.