Keynote Talk

Engineering Porous Ceramic Anodes via Additive Manufacturing for Green Energy Technologies

Maria Cannio[1,*], Dino Boccaccini[2]

[1,2] Resoh Solutions SRL, Modena, Italy , Dipartimento di Ingegneria "Enzo Ferrari", Università degli studi di Modena e Reggio

[2] Dipartimento di Ingegneria "Enzo Ferrari", Università degli studi di Modena e Reggio

[*]Corresponding author

ABSTRACT

Solid oxide cells (SOCs) are high-performance ceramic devices combining fuel flexibility, high efficiency, and minimal emissions, with applications ranging from power generation to reversible hydrogen production via steam electrolysis. In this study, we explore innovative additive manufacturing strategies for SOC anode supports, focusing on porous yttria-stabilized zirconia (3YSZ) fabricated via digital powder deposition followed by in-line pressing and compaction. The impact of compaction pressure on microstructure and functional properties was systematically assessed. Sintered specimens were characterized using X-ray computed tomography, scanning electron microscopy, mercury intrusion porosimetry, ultrasonic measurements of Young's modulus, and biaxial flexural strength testing. The results reveal a strong inverse correlation between compaction pressure and porosity, with Young's modulus and flexural strength decreasing exponentially as porosity rises. Fully processed 3YSZ supports demonstrate excellent potential as durable anodes for both solid oxide fuel cells and electrolysis cells. This work highlights the advantages of additive ceramic processing over conventional tape casting, including near-net-shape forming, reduced material waste, and lower capital investment, particularly for complex YSZ geometries. By linking processing conditions, microstructure, and mechanical performance, these insights provide actionable guidance for designing next-generation SOCs with enhanced reliability and performance.

Keywords: Solid oxide cells, anode support, additive manufacturing, ceramic processing, porous materials

DOI: 10.21467/abstracts.8.5 ISBN: 978-81-998984-8-6 (eBook)