Progress and Prospects in the Development of Metal Supported Proton Conducting Ceramics for Steam Electrolysis and Other Electrochemical Energy Conversion Devices

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Technological development of proton conducting ceramic cell (PCC) manufacturing is in progress. Both high electrochemical performance and robustness in long term operation are crucial for practical devices. The metal-supported (MS) architecture is one of the promising alternatives to the state-of-the-art ceramic supported SOCs, due to its high tolerance towards thermal/redox cycling that are key features for flexible and reliable operation in high temperature fuel cell and electrolysis applications. Relying on the perovskite-type PCC electrolyte, whose refractory nature requires high sintering temperatures in the conventional chemical processing route, the challenge in MS-PCC manufacturing is to achieve a gas-tight electrolyte layer without degradation of the metal substrate. Our strategy is the multilayer implementation combining wet chemical processing of the functional fuel electrode in air below 1000°C and Physical Vapor Deposition (PVD) techniques below 800 °C for the gas-tight electrolyte coating. PCCs are suitable for MS architecture, that can provide potentially high performances and high mechanical stability for a wide range of electrochemical applications.

We are working on the MS-PCC development in different projects. In the project DAICHI (EIG CONCERT-Japan, BMBF/01DR18002), we started with Pulsed Laser Deposition (PLD) to manufacture the gas tight electrolyte layer and obtained the first working MS-PCC in steam electrolysis application [1]. The concept is transferred to scalable techniques in projects ARCADE (BMBF/03SF0580A) and 112CO2 (Horizon 2020/952219). We will present our progress in the development of MS-PCC and discuss on the prospects to manufacture large-scale robust PCC cells at reasonable costs for different electrochemical applications.

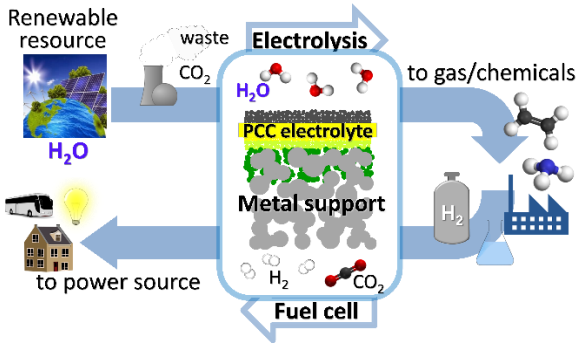

Figure 1. MS-PCC for fuel cell and Power-to-X applications

[1] Haoyu Zheng, Feng Han, Noriko Sata, Matthias Riegraf, Amir Masoud Dayaghi, Truls Norby, Rémi Costa, **Metal Supported Proton Conducting Ceramic Cell with Thin Film Electrolyte for Electrolysis Application**, *ECS Transactions*, 103 (1), 693-700 (2021)