

Helmholtz Call for Chinese Applicants Interested in Running for CSC 2021 Fellowship

- Helmholtz Centre:** Forschungszentrum Jülich GmbH – www.fz-juelich.de
- Department/Institute:** Institute of Energy and Climate Research, Materials Synthesis and Processing (IEK-1) https://fz-juelich.de/iek/iek-1/EN/Home/home_node.html
- Supervising scientist:** Prof. Dr. Olivier Guillon, Dr. Norbert H. Menzler, Dr. Mariya E. Ivanova
- University for registration or for a future degree:** Technical University Aachen (RWTH Aachen)
- Research Field:** Proton conducting ceramic cells
- Position open for:** **PhD Student** **X** **Sandwich PhD Student**
- Title of the research:** Towards a proton conducting cell with boosted performance and stability through advanced microstructural design

More description of research topic:

The research topic comprises the advanced design and investigation of microstructure of a proton conducting ceramic cell (PCC) and mechanical properties for durable operation in fuel cell and electrolysis mode. As choice of proton conducting materials, cell electrolyte will be based on a selected acceptor doped (AD) $\text{BaZr}_{1-x-y}\text{Ce}_x(\text{AD})_y\text{O}_{3-\delta}$ - a viable candidate for achieving the 400-500°C performance target and retaining reasonable thermo-chemical stability under various operation conditions. To make use of the high bulk conductivity of such materials and hence to achieve practical breakthrough for PCC-based electrochemical devices, the blocking nature of the grain boundaries has to be overcome either through i) tailored interfacial design incl. proper charge compensation or ii) indemnified by means of cell microstructuring towards thinner electrolytes with preferential orientation of the crystal grains along the transport direction of charges, or iii) a combination of two. Therefore, the major task will be to develop a specially designed anode supported cell with 1-2 μm -thick-electrolyte layer with preferential grain orientation. By that the transport pathways will be less impeded by the grain boundaries, while the overall performance will be largely dominated by material bulk (grain interior) properties. Additionally to that, a cell air electrode will be deposited, and finally the single cell performance will be characterized under relevant operation conditions. The desired dimensions of the cells are therefore 5x5 cm^2 . To achieve proper integrity of such a complex multilayered system and promising values of cell performance, the thermo-chemical compatibility of all adjacent materials/components will be examined, along with the mechanical properties on micro- and macroscopic level for single materials, more complex layered structures and the entire cell to address the current challenges towards the application relevant mechanical limits. Mechanical properties of single and layered systems will be investigated in cooperation Dr. J. Malzbender, IEK-2. This can be realized via advanced destructive and nondestructive characterization techniques in combination with optical and electron microscopy based microstructural characterization. Along with clarification of cell degradation mechanisms upon operation, such properties can serve as base for lifetime prediction models. The field is strongly interdisciplinary, while the local infrastructure and expertise will allow for using up-to-date processing and characterization techniques for advancing knowledge.

Specific requirements:

The applicant should have master degree in material science, chemistry, physics or related area, with good performance in university and post-graduate period. Basic knowledge of inorganic material synthesis and processing, microstructure design and electrochemistry is necessary.

- Working Place:** Forschungszentrum Jülich, Germany (near Cologne)
- Earliest Start:** September 2021
- Language Requirement:** Very good knowledge of English language, written and spoken. German language courses are organised in the context of our in-house training program and are free of charge.
- Name and Address of the Supervisor:** Prof. Dr. O. Guillon, Forschungszentrum Jülich GmbH, Institute of Energy and Climate Research (IEK-1), 52425, Jülich, Germany
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