PAUL SCHERRER INSTITUT

Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

**Prof. Dr. Thomas J. Schmidt**
Division Head
Energy & Environment
Paul Scherrer Institut

CH-5232 Villigen PSI, Switzerland
thomasjustus.schmidt@psi.ch

Chair for Electrochemistry
Laboratory of Physical Chemistry
Department of Chemistry and Appl. Biosciences
ETH Zürich
Vladimir-Prelog-Weg 2
CH-8092 Zürich, Switzerland
thomas.schmidt@phys.chem.ethz.ch

Villigen PSI, March 26, 2021

**To Whom It May Concern**

**Reference Letter**

Hong Xu joined the Paul Scherrer Institut (PSI) in December 2016 as a PhD student working on a project funded by the Swiss National Science Foundation. He successfully finalized his thesis in January 2021 at ETH Zurich in the Department of Chemistry and Applied Biosciences. The objective of his project was to develop methodologies for operando sub-second imaging of water in low temperature fuel cells (PEFCs), specifically within the porous structures of the gas diffusion layers. He intensly collaborated with a second PhD student from the Tomcat beamline (X-ray tomography beamline at the Swiss Light Source, SLS).

Hong Xu's thesis encompassed the following topics:

- collaborate on the further development and characterization of the PEFC *operando* sub-second X-ray tomographic imaging and conduct imaging campaigns at the Tomcat beamline.
- elaborate a semi-automated imaging evaluation pipeline for segmenting large (> 50 3D images) time series of imaging data.
- apply the advanced fast imaging and image evaluation technology to the understanding of *operando* dynamic water saturation and desaturation (evaporation) of water in different GDL materials.
- apply this technology to the understanding of water transport modes in GDL at different temperatures.

Hong Xu's thesis is clearly addressing very hot topics in the research and development of PEFC imaging. This thesis, thanks to his persistence of pursuing his work very carefully, without doubt, shows results, which are

pushing the limits of operando PEFC imaging using X-ray Tomographic Microscopy. His results clearly show the world-wide unique capability of subseconds and submicron resolution imaging of operating PEFCs.

At the time of writing of this reference letter, Hong Xu has published 2 articles as first author in peer-reviewed journals with further 2 articles in preparation. He attended 5 conferences with 3 oral and 2 poster contributions. He also acted as a teaching assistant for 3 lectures at ETH.

We thank Hong Xu for his commitment to the project and the team-spirit he brought to the group. The outcome of his work triggered a follow-up PhD project on sub-second imaging of electrochemical devices. We are convinced that his professional and team-oriented attitude and well-developed people skills will enable him to bring success to his future tasks and assignments. We are wishing him all the best for his professional career and private life.

If you have further questions, please do not hesitate to contact us and we can give many more details.

Yours sincerely,

Prof. Dr. Thomas J. Schmidt

Division Head
Energy & Environment,
Paul Scherrer Institute
and
Chair for Electrochemistry ETH Zürich

Dr. Felix Büchi

Head Electrochemistry Laboratory
Paul Scherrer Institute