Contribution ID: **241** Type: **poster**

Distinction of liquid water and ice based on dual spectrum neutron imaging

Wednesday, 18 September 2013 12:15 (2 hours)

Polymer electrolyte fuel cells (PEFCs) have attracted much attention during the last decade, because of extremely low emissions at very high power densities. However, before its commercialization, PEFC have to prove its durability at ambient conditions, particularly during operation at subfreezing temperatures. As the freezing mechanism inside PEFCs is not fully understood in literature, imaging methods have to be improved to enhance the understanding. In this poster, we would like to present a visualisation method to identify phase transitions of water based on dual spectrum neutron imaging.

The attenuation of neutrons passing through a specimen is strongly dependent on the energy spectrum of the beamline. It has been shown [1,2] that the attenuation of water increases with decreasing neutron energy and differences between the frozen and liquid aggregate state can be measured at very low neutron-energy. Unfortunately, in this energy region, the flux is rather low at the cold neutron imaging beamline, ICON [3], of the Paul Scherrer Institut and no significant deviations between liquid and solid phase can be distinguished with the full beam spectrum. Introducing a polycrystalline beryllium filter inside the neutron beam, the low energy part of the spectrum is emphasized and phase transitions between liquid water and ice are more distinctive. As the water distribution may change over time, consecutive images are captured with and without filter (dual spectrum).

In the first part, we would like to present results based on a cylindrical water column. Those measurements provide reference values for the attenuation coefficient at different aggregate states. As expected, due to the decreasing attenuation of water with increasing energy [1,2], differences between the liquid and frozen aggregate state were identified. Despite the fact that the change in attenuation between the aggregate states is only 1.8%, phase transitions were clearly identified based on dual spectrum neutron imaging.

Subsequently, this imaging setup has been applied to a fuel cell. Surprisingly, the measured ratios of attenuation (with and without filter) were not consistent with the reference water column measurements. Nevertheless, phase transitions between liquid water and ice in the fuel cell can still be identified with this method.

[1] L. Torres, J.R. Granada, J.J. Blostein, Nucl. Instrum. Meth. B 251, 304 (2006)
[2] L. Josic, E.H. Lehmann, D. Mannes, N. Kardjilov, A. Hilger, Nucl. Instrum. Meth. A 670, 68 (2012)
[3] A.P. Kaestner, S. Hartmann, G. Kühne, G. Frei, C. Grünzweig, L. Josic, F. Schmid, E.H. Lehmann, Nucl. Instr. Meth. A 659, 387 (2011)
[4] Y. Ishikawa, H. Hamada, M. Uehara, M. Shiozawa, J. Power Sources 179, 547 (2008)
[5] P. Oberholzer, P. Boillat, R. Siegrist, R. Perego, A. Kaestner, E. Lehmann, G.G. Scherer, A. Wokaun, J. Electrochem. Soc. 159, B235 (2012)

Primary author: Mr BIESDORF, Johannes (Paul Scherrer Institute)

Co-authors: Dr KAESTNER, Anders (Paul Scherrer Institute); Dr LEHMANN, Eberhard (Paul Scherrer Institute); Mr BERNAUER, Felix (Paul Scherrer Institute); Mr VONTOBEL, Peter (Paul Scherrer Institute); Dr BOILLAT, Pierre (Paul Scherrer Institute); Mr OBERHOLZER, Pierre (Paul Scherrer Institute); Prof. SCHMIDT, Thomas J. (Paul Scherrer Institute)

Presenter: Mr BIESDORF, Johannes (Paul Scherrer Institute)

Session Classification: Poster session I and lunch