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Proton exchange membranes for fuel cell applications studied with the Pulsed Low Energy Positron System (PLEPS)

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A fuel cell is one of the future promised power sources that produce electricity through an electrochemical reaction of hydrogen and oxygen without producing harmful products. Crosslinking PVA/SSA proton exchange membranes were prepared at different concentrations of SSA (5-30 wt.%) using casting technique. SO3 groups added by crosslinking with SSA are responsible for modifying the membrane properties as follows: The ionic conductivity of the membranes was enhanced by increasing both temperature and SSA concentration. There is no significant change in the tensile strength of the membranes at a low concentration of SSA (<15 wt.%), above 15 wt.% it decreases significantly. PLEPS operated at the NEutron induced POsitron source MUniCh (NEPOMUC) at FRM II was used to investigate the free volume properties of the prepared membranes. The positron lifetime was measured using a moderated positron having an energy of 16 keV, which provides a mean implantation depth of about 2.8 μm. It is interesting to find that, at low SSA concentration (less than 15 wt.%) the hole volume did not change but increased significantly above 15 wt % SSA. We found that there is a strong correlation between water uptake, proton conductivity and tensile strength with the properties of the free volume.

Primary authors: Mr GOMAA, Mahmoud (Heinz Maier-Leibnitz Zentrum (MLZ) and Physik-Department E21, Technische Universität München); Dr HUGENSCHMIDT, Christoph (Heinz Maier-Leibnitz Zentrum (MLZ) and Physik-Department E21, Technische Universität München); Dr DICKMANN, Marcel (Heinz Maier-Leibnitz Zentrum (MLZ) and Physik-Department E21, Technische Universität München); Prof. E. ABDEL-HADY, Esam (Physics Department, Faculty of Science, Minia University); Prof. F. M. MOHAMED, Hamdy (Physics Department, Faculty of Science, Minia University); Prof. O. ABDEL-HAMED, Mohamed (Physics Department, Faculty of Science, Minia University)

Presenter: Mr GOMAA, Mahmoud (Heinz Maier-Leibnitz Zentrum (MLZ) and Physik-Department E21, Technische Universität München)

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