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Contrast-Variation Small-Angle Neutron Scattering – A Powerful Method to Unravel the Micro-Structure in Polymer Electrolyte Membranes.

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Specially designed polymer electrolyte membranes for fuel cells (PEMFC) applications must present special properties such as high ionic conductivity, adequate mechanical strength, chemical and electrochemical stability under operating conditions, moisture control in stack, and low cost production. Currently, the most used material for such applications is the Nafion, which, despite its excellent properties, shows some disadvantages such as the high cost and the need for special safety and supporting equipment during its manufacture and use. This has prompted the research towards alternative polymers. On the other hand, the properties of PEMFCs derive from the micro-phase separation of a hydrophilic ionic material from a hydrophobic substance. Therefore, for newly designed PEMFCs the understanding of the micro-structure, such as crystalline domains, conducting regions, as well as distribution of ionic groups and water in conducting regions is essential for optimizing the relationship between structure and properties.
Through the manipulation of the scattering contrast between different regions and components of such complex systems the small-angle neutron scattering (SANS) enables a detailed and unique micro-structural characterization under functional conditions of temperature and humidity. In this communication the principle and representative examples of experimental investigations carried out on new PEMFCs at the KWS-2 SANS instrument of JCNS at MLZ will be reported.

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