SUCCESS STORY

Polymers4Hydrogen
Decarbonizing of energy infrastructure using novel polymers

programme: COMET – Competence Centers for Excellent Technologies

programme line: COMET-Modul

sub project: New experimental methods and simulation approaches to achieve a reliable prediction of the permeation of hydrogen gases through polymer composites, 01/2020-12/2023, multi-firm

EFFICIENT CHARACTERIZATION OF THE PERMEATION PROPERTIES OF POLYMER MATERIALS

IN ADDITION TO THE NEW TEST CHAMBER FOR PERMEATION MEASURMENTS, A MODEL WAS DEVELOPED THAT SIGNIFICANTLY REDUCES THE COSTS FOR A COMPLETE CHARARACTERIZATION OF POLYMER MATERIALS.

The difficulty of hydrogen storage

Hydrogen, a CO_2-free energy carrier, is one of the most promising strategies for achieving the global climate targets by 2050. While the production of hydrogen and its conversion into electrical energy is already very efficient, the storage of hydrogen with a high energy density combined with low volume and weight of the storage solution is crucial for the success of hydrogen technology.

In particular, storage of gas under high pressure remains an attractive concept for hydrogen storage, as it offers a high energy-to-weight ratio at low cost, which is crucial for the applicability of storage systems in mobility and transportation. The necessary gas pressures in the storage and piping systems place high demands on wall and sealing materials. Good storage systems with the lowest possible hydrogen losses in a storage cycle require the selection of suitable materials. It must be ensured that the advantageous properties of those materials remain largely unchanged over wide temperature and pressure ranges.

Characterization with few measuring point

In measurement technology, characterization refers to the complete measurement of the properties of an object or system in relation to external influences. Such a characterization was made possible by the development and production of a permeation measuring chamber within the framework of the Polymers4Hydrogen module (Figure 1). This chamber can be used to measure the permeation properties of materials of scientific or industrial interest at

pressures of up to 100 MPa in a temperature range between 0° and 85° C. This allows a comprehensive characterization of the barrier properties of polymeric materials for use in corresponding storage systems as a function of pressure and temperature. However, the duration of the individual measurements can vary between several hours and several days, depending on the barrier properties of the material in question, which is why these measurements are not only time-consuming but also cost-intensive.

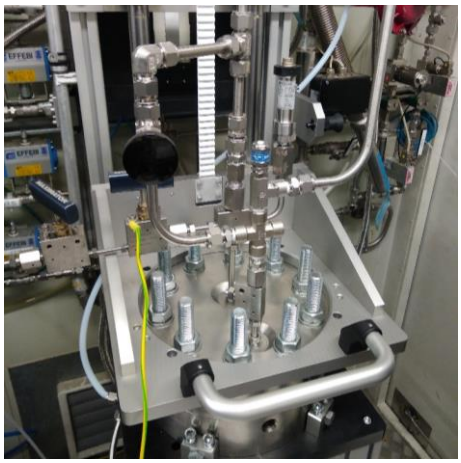

Figure 1: Newly developed permeation measuring chamber (up to 100MPa)

Within the framework of Polymers4Hydrogen a model was therefore developed with which the permeation coefficients can be predicted as a function of pressure and temperature using just a few measuring points (red symbols in Figure 2).

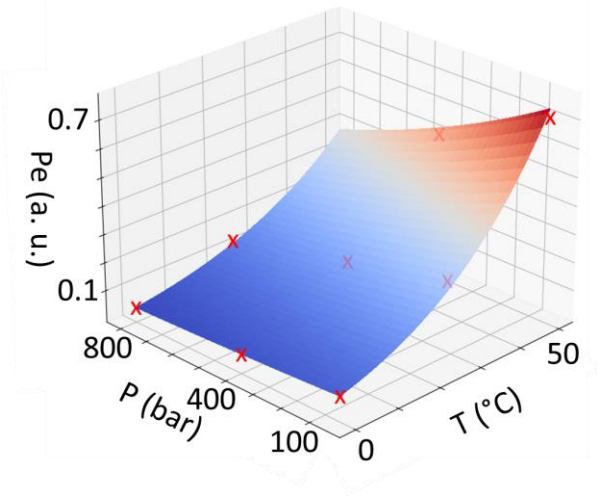

Figure 2: Complete characterization of a material based with just a few measurements

Impact and effects

The measuring chamber developed in the COMET module "Polymers4Hydrogen" in conjunction with the new characterization model allows the efficient and therefore cost-effective characterization of the permeation properties of polymers. The model was mathematically generated in such a way that it is possible to extrapolate the permeation properties beyond the measurement range to a certain extent. This is particularly interesting for modelling materials, as it allows material properties to be defined for pressure and temperature ranges that cannot be measured.

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- SKF Sealing Solutions Austria GmbH, AT
- Bundesanstalt für Materialforschung und -prüfung, DE
- Hydrogen Center Austria, AT

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