

**Polymers4Hydrogen
Decarbonizing of energy
infrastructure using novel polymers**

Program: COMET – Competence Centers for Excellent Technologies

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Single 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



MODEL-BASED DEVELOPMENT OF POLYMER MEMBRANES AS HYDROGEN BARRIERS

THE ESTABLISHMENT OF NEW MODELS AND SIMULATION METHODS ALLOWS FOR A FASTER AND MORE COST-EFFECTIVE DEVELOPMENT OF FILLED POLYMER MATERIALS AS BARRIER MEMBRANES IN H₂-TANK SYSTEMS.

Polymers for Hydrogen Storage

In order to achieve the global climate targets by 2050, energy generation and conversion needs to be accelerated worldwide away from fossil fuels and towards alternative energy sources that produce electrical power. In particular, hydrogen technology is characterized by the fact that the electrical energy can be stored chemically after conversion into hydrogen gas. By using a fuel cell, the energy stored in the hydrogen can be used again as electrical energy.

An important aspect is that hydrogen has to be reliably stored with high energy density in tank systems so that hydrogen technology represents an attractive alternative to battery and combustion

systems. Among many known storage concepts for hydrogen, high-pressure gas storage remains one of the most favorable storage solutions with excellent weight-to-energy ratio, an important measure for the applicability of tank systems.

Polymer materials offer the advantage that, on the one hand, they have a far lower density compared to metallic materials, thus enabling lighter tank systems, and on the other hand, unlike metals they generally do not exhibit hydrogen-related chemical aging. However, a challenge in the use of polymers for high-pressure hydrogen systems lies in their considerably higher permeability for gases compared to metals.

For this reason, new polymer materials for high-pressure hydrogen systems are being developed in

SUCCESS STORY

the COMET module "Polymers4Hydrogen" at the Polymer Competence Center Leoben GmbH.

Fillers Enhance the Barrier Properties

In particular, fillers determine the properties of polymers to a large extent. High-aspect-ratio inorganic fillers are commonly used to extend the path of diffusing permitting hydrogen molecules through the polymer membrane and thus increase its effective barrier properties (Figure 1).

New models and simulation methods have been created that can predict the effect of fillers in polymer materials. It was observed that the addition of fillers even in the lower percentage range can increase the barrier properties of polymer materials to a large extent.

Impact and Effects

The models and simulation approaches developed in the COMET module "Polymers4Hydrogen" and the virtual prediction of the influence of fillers on barrier properties will allow for a faster and more efficient development of tailored polymer materials for

hydrogen storage systems. This will result in safer, lighter and cheaper tank systems for the mobile sector.

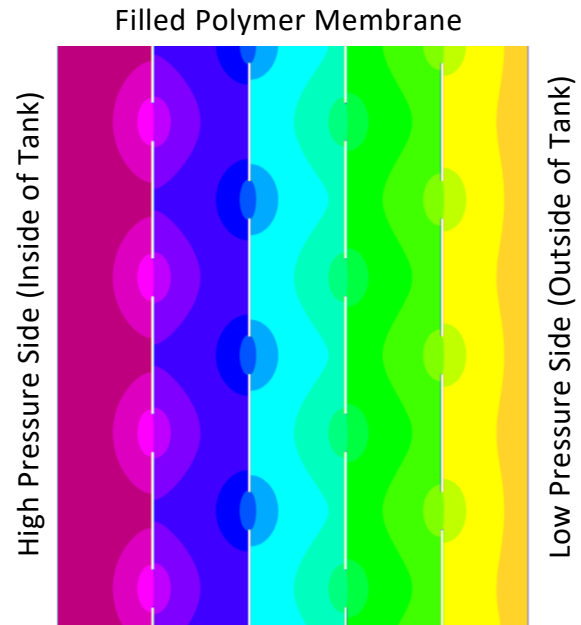


Figure 1: 2D permeation simulation of a filled polymer membrane

Project Coordination (Story)

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- Hydrogen Center Austria, AT
- Contitech Rubber Industrial Kft, HU
- Bundesanstalt für Materialforschung und -prüfung, D
- Montanuniversität Leoben, AT

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