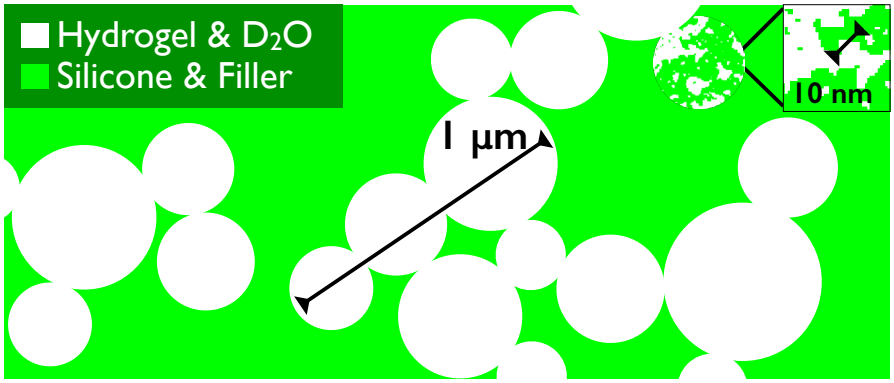
Micrometer structure of interpenetrating polymer networks

In this project, researchers from University of Copenhagen collaborated with Biomodics to study the structure of interpenetrating polymer networks (IPNs) on a micrometer scale using neutron scattering.

Biomodics use their proprietary IPN technology to create medical devices containing both hydrophobic silicone and hydrophilic hyddrogel. These can reduce the risk of infections and can even be used for the controlled administration of drugs to targeted areas.

The IPN structure is hierarchical, with important structures on length scales ranging over seven orders of magnitude, from ångströms to millimeters. The structure is challenging to study because of the lack of contrast between the two polymers in optical or X-ray experiments. In a previous project, highlighting the structure with heavy water (D_2O) revealed structures on the nanometer-scale using small-angle neutron scattering (SANS). In this project, these investigations were extended from the nanometers to the micrometers using spin-echo small angle neutron scattering (SESANS).



While the previous SANS experiments studied the IPN structure on a nanometer length scale, SESANS measurements probe inhomogeneities in the micrometer range. The results revealed that the material is divided in spherical regions of hydrogel-rich material in otherwise hydrogel-poor material.

What we did

- Samples of Biomodics IPNs were soaked in heavy water (D_2O) and measured with SESANS at the Technical University of Delft.
- Structural parameters were extracted by mathematical modelling of the data.
- The experiments complement previous small-angle scattering data and extend the understanding of the material from the nanometer to the micrometer scale.

What's next?

The next step will be to study the drug delivery properties of different IPNs and how this is connected to the nano- and micro-structure.

"It turns out that our IPN material has structures on very different length scales. This means that we can fully exploit the drug delivery potential of the hydrophilic polymer without compromising the strength of silicone. The combination of SANS and SESANS means that we now understand the structure in both the nanometer and micrometer size range."

- Peter Thomsen, CEO, Biomodics

In the LINX project, researchers at leading Danish universities collaborate with scientists in industry to solve industry relevant problems using advanced neutron and X-ray techniques. The Arleth group at University of Copenhagen contributes with their expertise in small-angle scattering techniques.

Read more
linxproject.dk

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LINX Linking Industry to Neutrons and X-rays
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