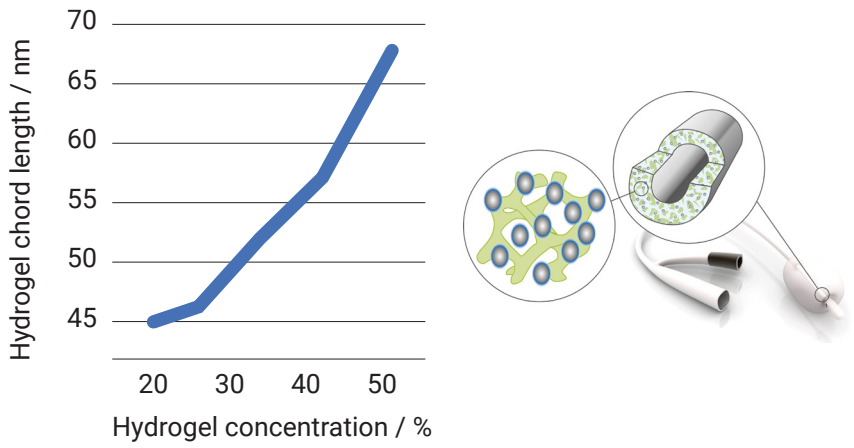
Interpenetrating polymer networks for drug delivery

In this project, researchers from University of Copenhagen collaborated with Biomodics to study the structure of interpenetrating polymer networks (IPNs) with small-angle neutron scattering (SANS). Using contrast highlighting with heavy water (D_2O) made it possible to study the distribution of hydrogel in the silicone matrix.

Biomodics use their proprietary technology of IPNs of hydrophobic silicone and a hydrophilic polymer to create medical devices that reduce the risk of infections. The materials can even be applied for controlled administration of drugs to targeted areas.

Understanding the structure of IPNs is crucial for designing materials with properties that are just right for the intended use. Unfortunately, the two polymers constituting the IPN look identical in microscopes, and even with X-rays.



Soaking Biomodics IPNs in heavy water (D_2O) highlights the hydrogel structure when analysed with neutrons. This enables a determination of characteristic sizes from the SANS data. One important parameter is the chord length, which is a measure of the average size of the hydrogel domains.

What we did

- Samples of Biomodics IPNs were soaked in heavy water and measured with small-angle neutron scattering at the FRM-II research reactor in Munich.
- Mathematical modelling was applied to the data to extract structural parameters.
- The analysis elucidated the nanoscale distribution of hydrogel in the silicone matrix.
- Complementary techniques were used to exclude phase separation of silicone and hydrogel on the micrometer scale.

What's next?

The next steps will be to study changes of hydrogel structure with varying processing conditions in order to be able to create a material with optimised properties.

— SANS is great for investigating structures at length scales between 1 and 100 nm so it is a good fit for Biomodics IPNs. Understanding the morphology of our materials helps us engineer the right structure for sustained local drug delivery.

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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