Industrial Applications

in Life Science
using Neutrons & X-rays

Sindra Petersson Årsköld
Senior Advisor, Associate Professor

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MEDICINE & HEALTH
ENERGY
ENGINEERING
WORLD AROUND US
ess
Drug development
Better batteries
Lighter, stronger materials
Advanced data storage
Neutrons and X-rays:
Fundamental science close to applications.
In industrial R&D, new knowledge is converted to practical solutions.
Cellular biology
Improved solar cells
Better catalytic systems
Examining artefacts

Protein crystallography in the pharma sector

Elucidating drug target – drug candidate interactions for better drugs

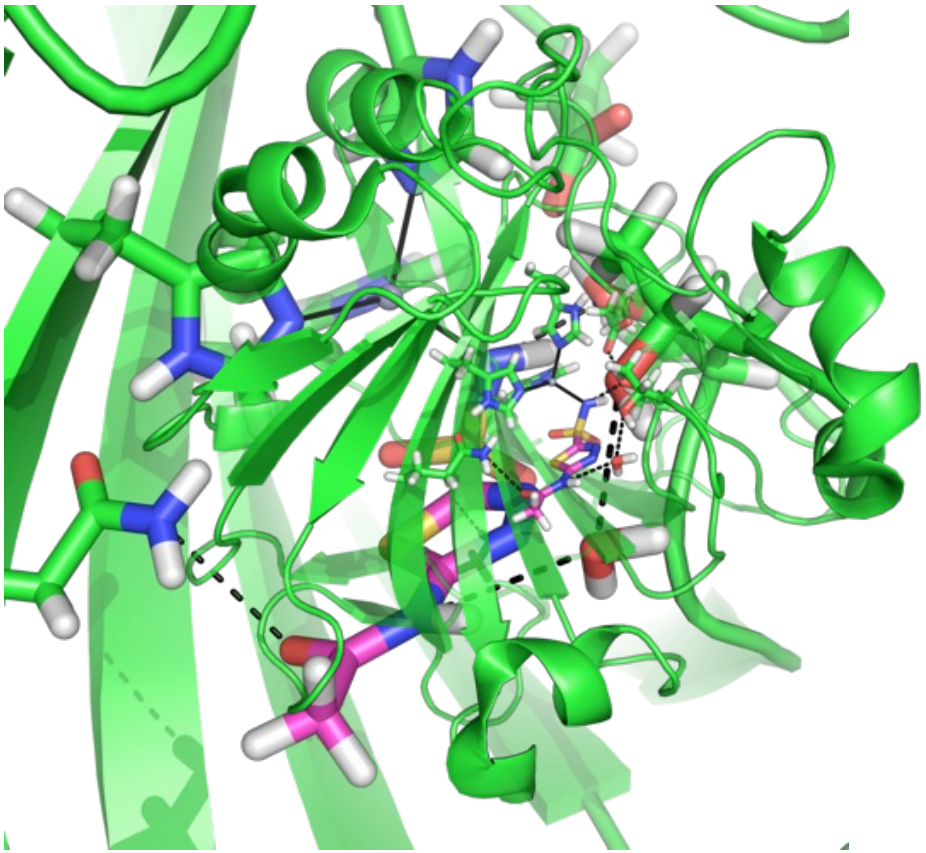


Image: Fisher, S. Z. *et al.* 2012 JACS

The enzyme carbonic anhydrase transports CO_2 and regulates blood acidity. It is a major player in some cancers, glaucoma, obesity and high blood pressure.

X-ray and neutron crystallography show how the drug Acetazolamide binds

Neutrons unambiguously pinpoint the protons, enabling structure-based drug development.

Neutron reflectometry in home-care diagnostics

Neutrons make pregnancy tests more sensitive and less costly

Pregnancy tests are immunoassays. They use the specific binding of an antibody to measure the concentration of antigens in a urine sample. The antibodies in the test are immobilized.

Neutron reflectometry showed that:

- the structural orientations of the immobilised antibodies must be controlled for best efficiency,
- there is a maximal antibody quantity above which no product improvement is achieved.

- it is important to have a blocking protein (human serum albumin, HSA, was used) as it avoids false positives.

B. J. Cowsill, X. Zhao, T. A. Waigh, S. Eapen, R. Davies, V. Laux , M. Haertlein , V. Trevor Forsyth, and J. R. Lu, *Langmuir*, 2014, 30 (20), pp 5880–5887

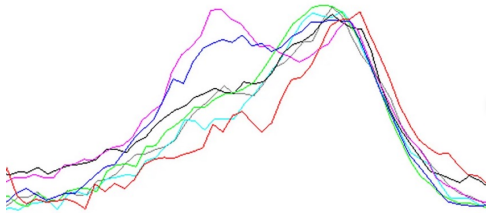
Drug formulation

X-ray powder diffraction quantifies unwanted drug polymorphs in pills

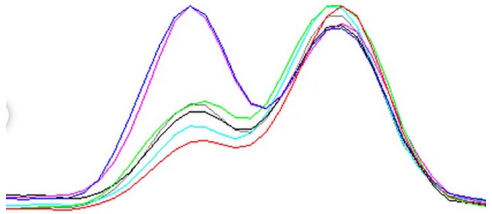
When manufacturing a pharmaceutical product, the active pharmaceutical ingredient can exist in different crystalline forms other than the desired one, so called polymorphs.

In order to optimize the manufacturing process there is a need to accurately measure the amount of wanted and unwanted polymorphs, even at very low concentrations.

Lab equipment



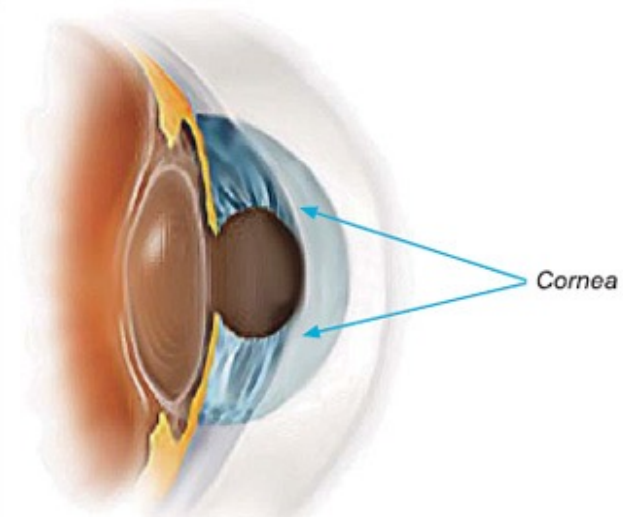
DanMAX



magle chemoswed.

Advanced implant materials

SANS reveals structure in cornea implant material



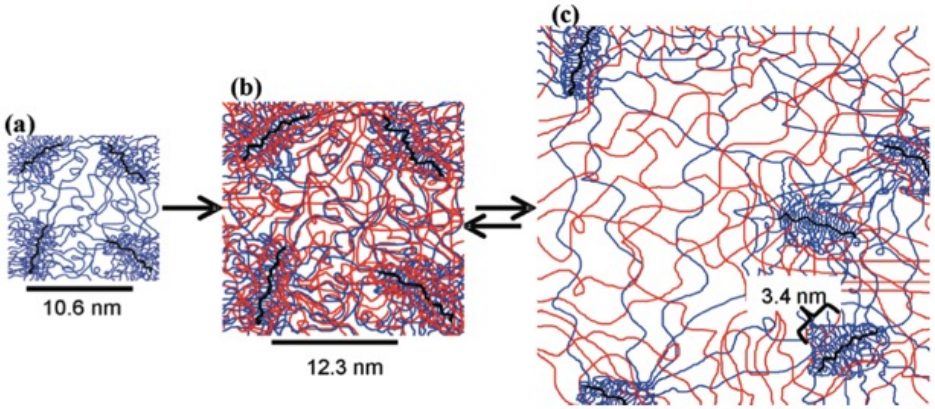
Swelling of a double network hydrogel designed for use as a cornea replacement.
(Frank Group, Stanford)

Double network hydrogels provide strength and resiliance together with high water content.

Gel structure forms over **multiple length scales.**

Kinetics of gelation can be rapid needing **sub-second** time resolution.

Neutrons provide the structure of each component in the presence of the other.



Advanced implant materials

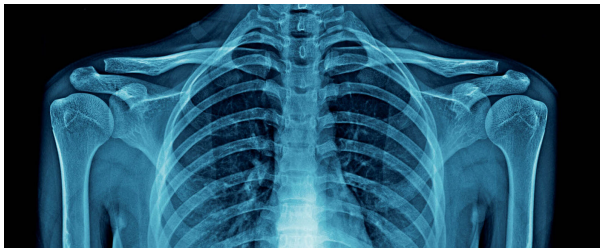
X-ray tomography investigates a biomaterial to reinforce bones

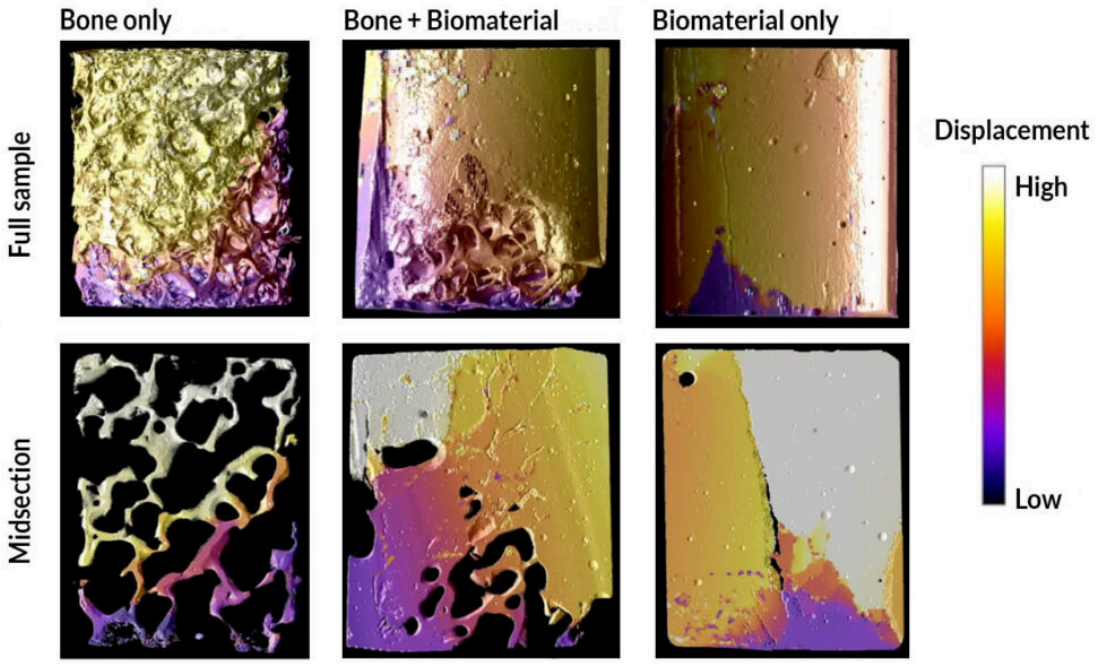
How does the biomaterial behave once injected in the bone? How does it interact with the native bone material? Does it improve the bone response to mechanical stress?

Answering these questions involves understanding how the bone and the biomaterial interact during the application of physical pressure.

Synchrotron-based X-ray tomography allowed the team to carefully observe increasing stresses and their consequences in the biological structure.

These experiments showed that the biomaterial produced by BoneSupport absorbs the loading in place of the native bone structure, thus helping the bone to better withstand mechanical stress.





BONESUPPORT™

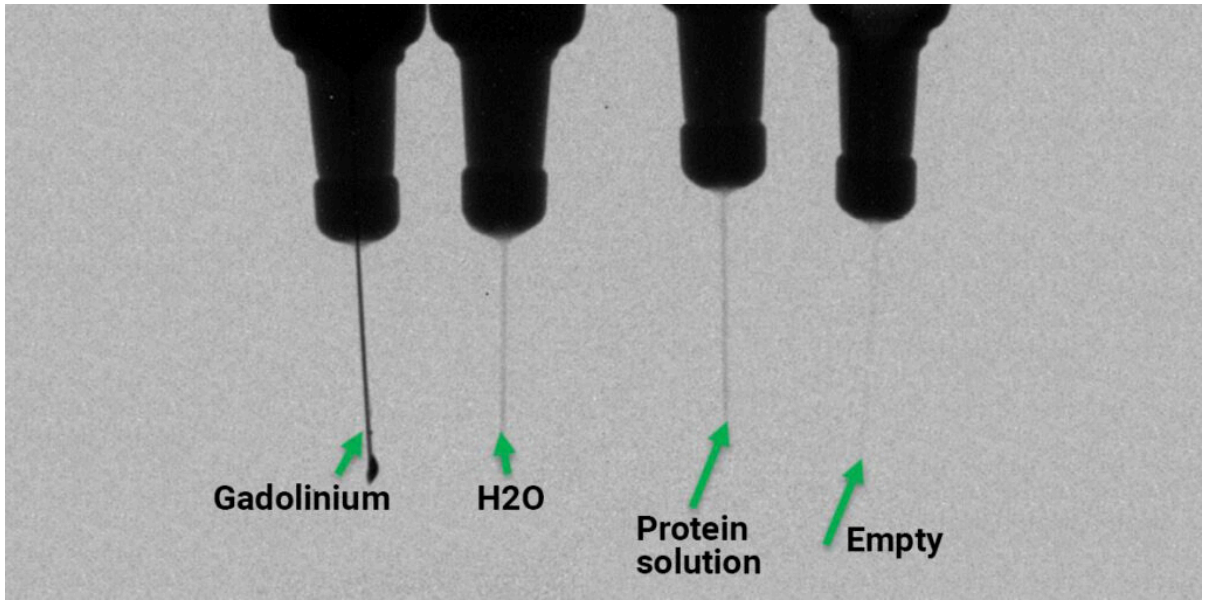
Improving health-care equipment

Identifying leaking syringes with neutron radiography

The biopharmaceutical company Sobi together with neutron experts from RISE used neutron radiography for the detection of leakages in prefilled syringes.

The results show the potential of this technique in detecting leaks, with significant advantages for design and quality assurance in syringe production.

This is an important achievement that can help Sobi assessing issues in manufacturing and syringe design.



SWEDISH ORPHAN BIOVITRUM

How does industry access the facilities?

Standard access :

- Open to all, selection by scientific excellence of the project.
- Free of charge
- Publication required

Proprietary access:

- Pay for access
- Keep project & results confidential

ILL estimates that 15% or more of their beam time is used for academic/industrial collaborations.

Mostly through collaborations with academia!

How does industry access the facilities?

The facilities provide a level of service, but the company also needs to have competence.

Building in-house competence is an extensive and time-consuming task.
Big Pharma do it.

Smaller companies or less frequent users can use mediator companies, who specialize.

Collaboration with specialists in academia is common.


Thank you!