Structural changes under controlled humidity conditions

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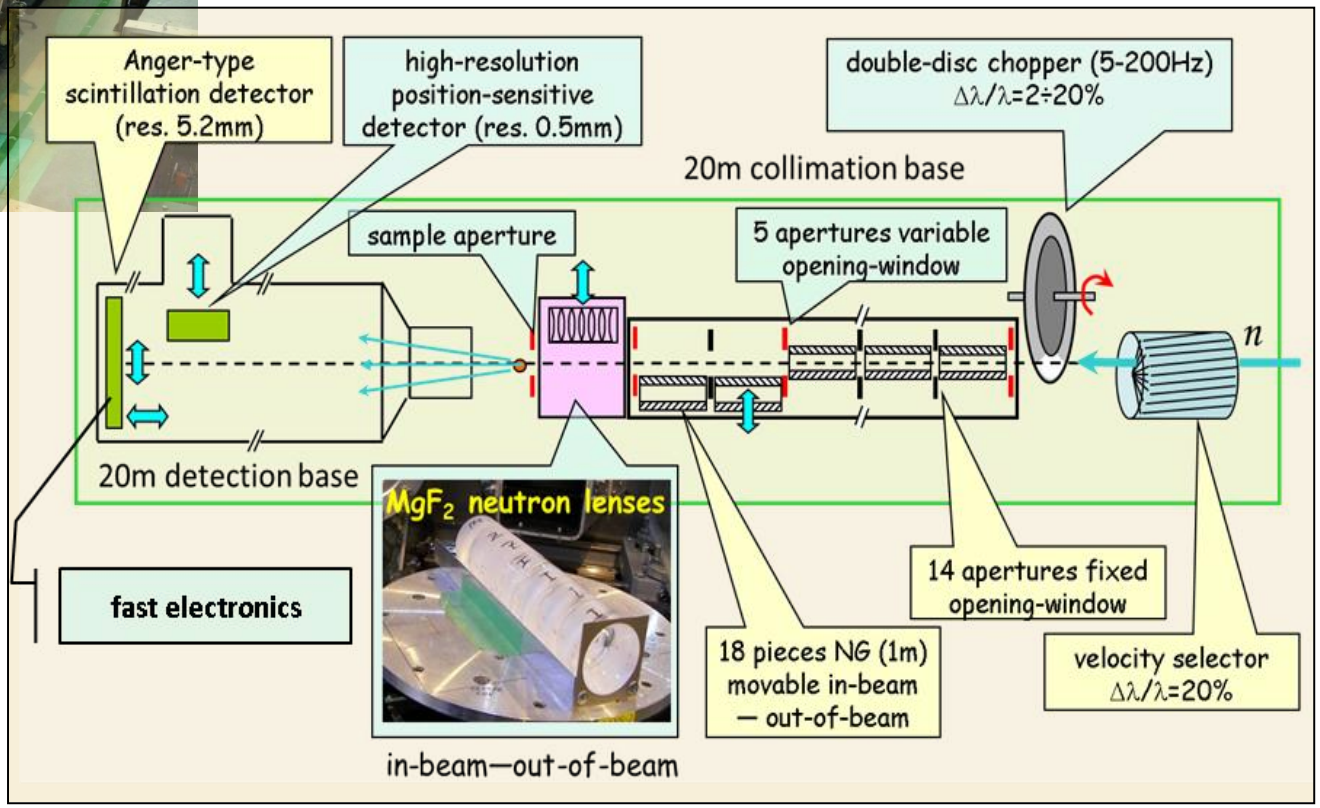
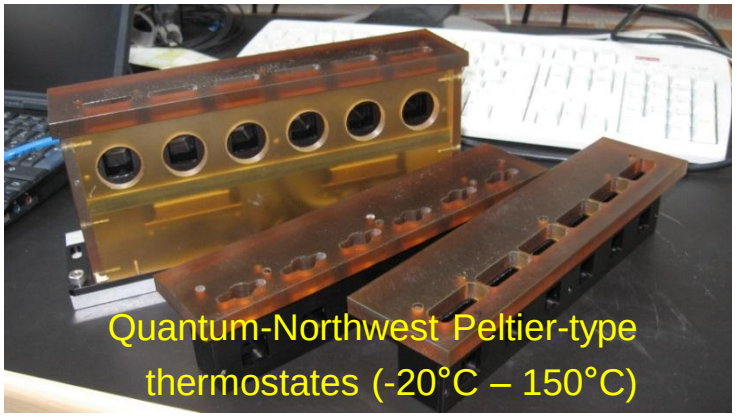
KWS-2 SANS Diffractometer



Sample environment

RT multiposition (27-36) / multilevel (3) holder for cells with different geometries

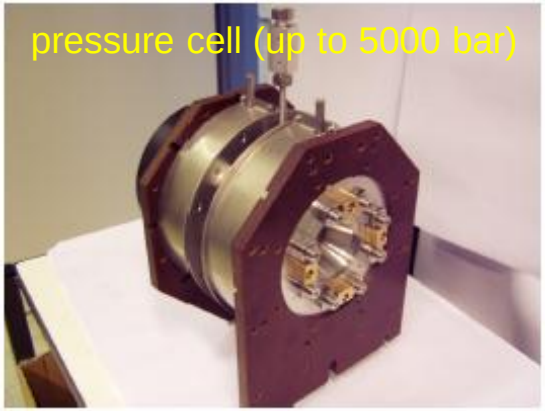


Quantum-Northwest Peltier-type thermostates (-20°C – 150°C)

stopped-flow

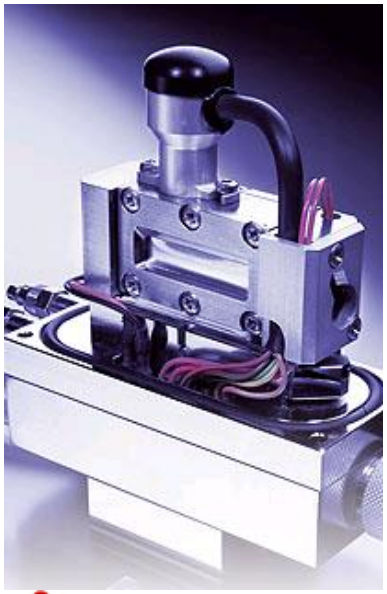
Anton Paar rheometer

low background cryostat (sapphire windows)



pressure cell (up to 5000 bar)

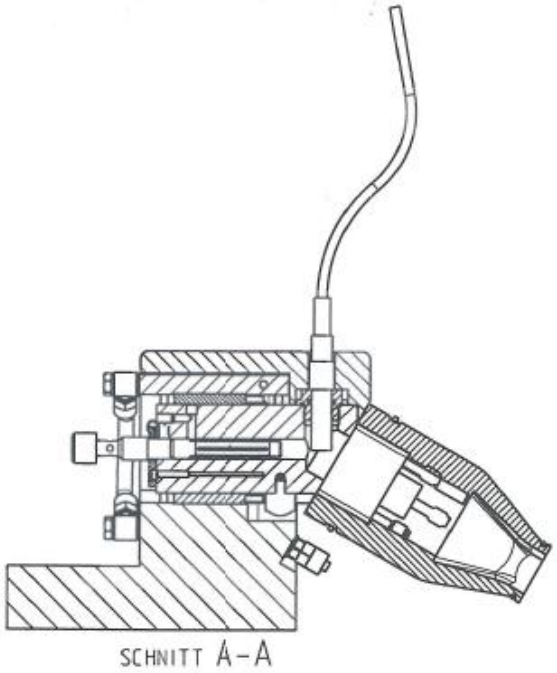
Humidity chamber



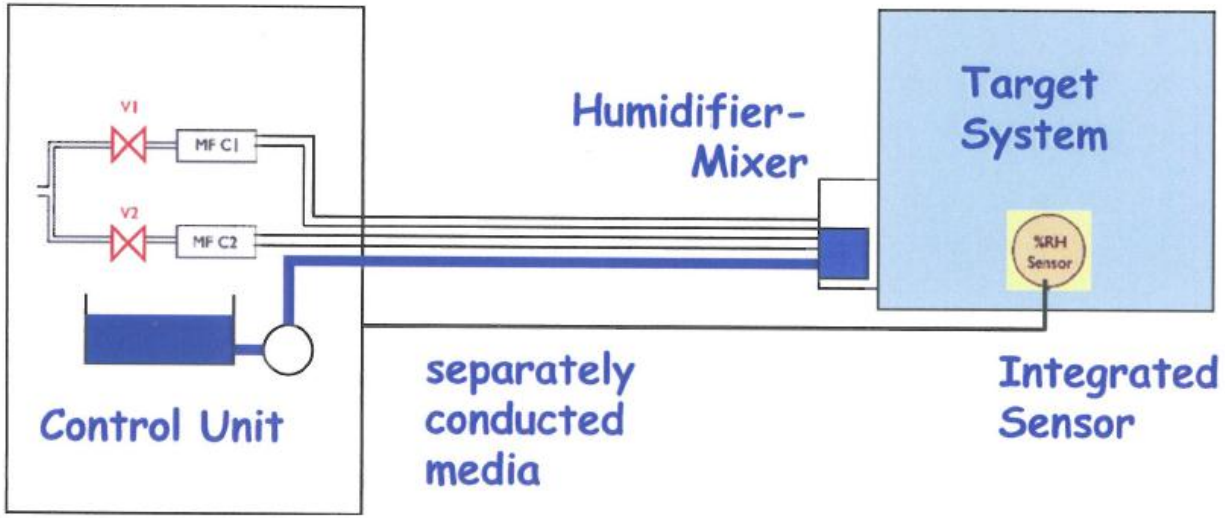
Anton Paar

RH: 5 - 95%

Temperature: 10-60 °C



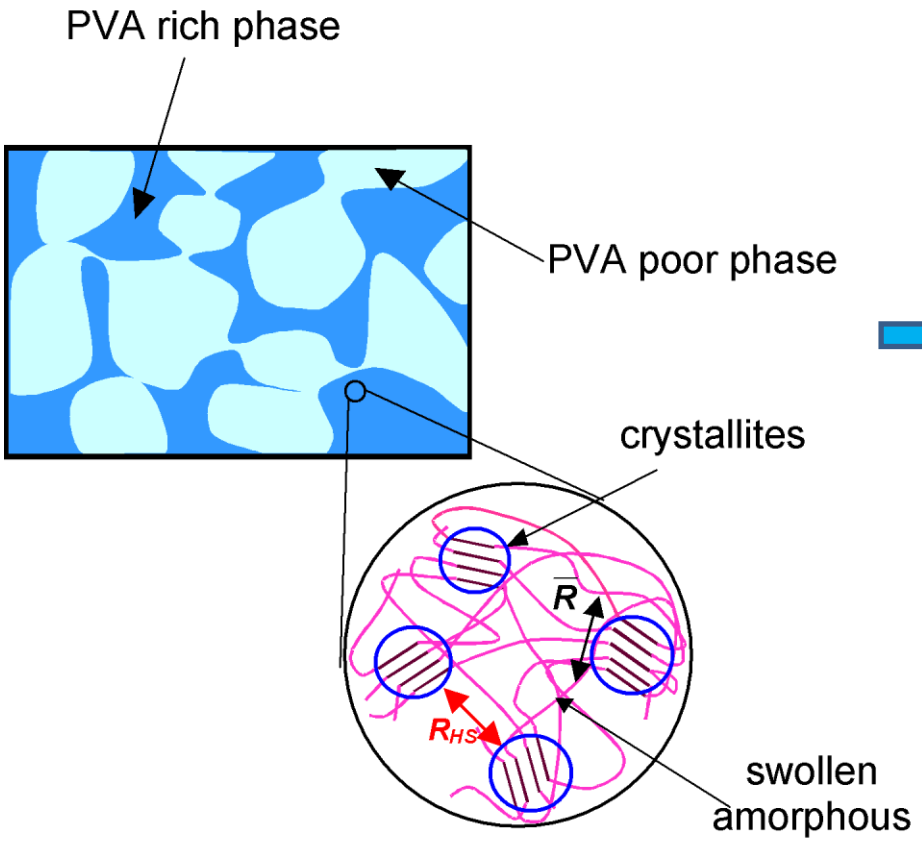
Humidity chamber

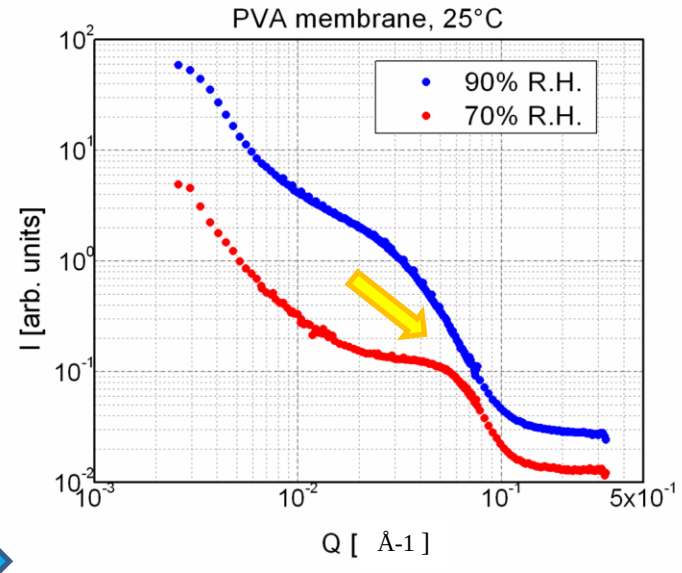


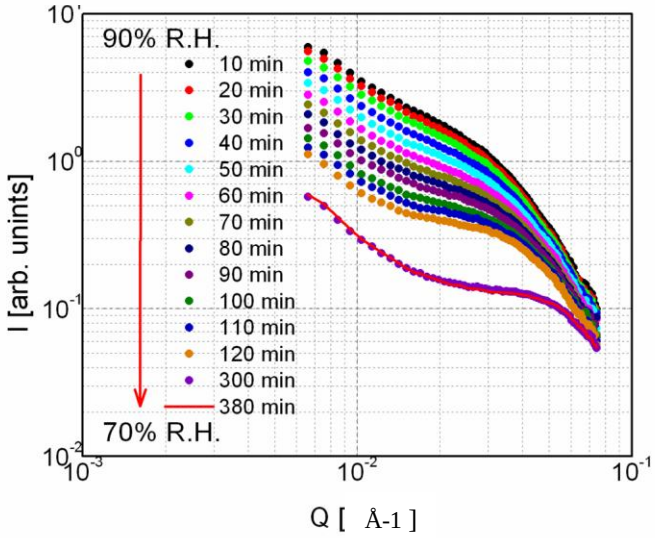
PVA gels

New sample environment: humidity chamber

test & commissioning with
PVA – cross-linked polymer & crystallite junctions







Epoxy-hydrogels

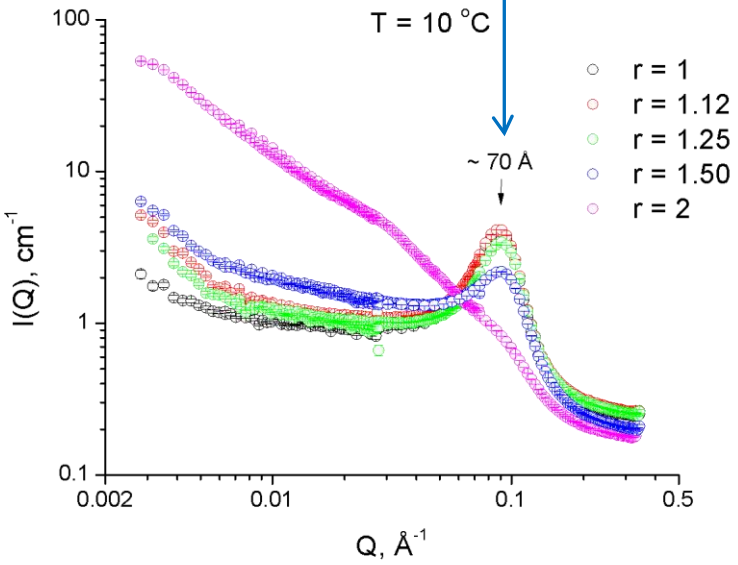
α,ω-diamino terminated poly(oxypropylene)-poly(oxyethylene)-poly(oxypropylene) (POP-POE-POP) block copolymer + diglycidyl ether of Bisphenol A propoxylate (PDGEBA)

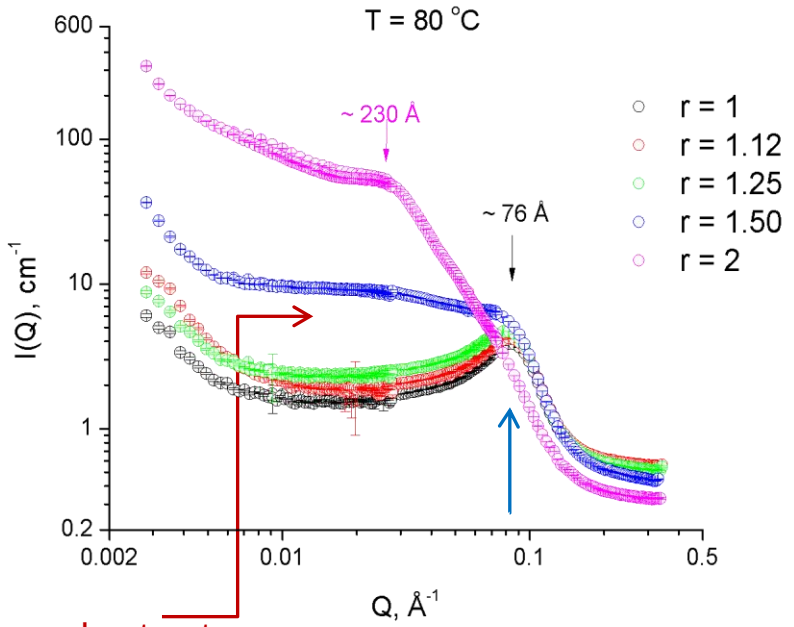
r=2[NH2]0/[E]0: r=1.00, 1.12, 1.25, 1.50 and 2.00 swollen to equlibrium in D2O

POE-water interaction → temperature, pressure] dependent

Structure ⟺ temperature

Inter-domain distances

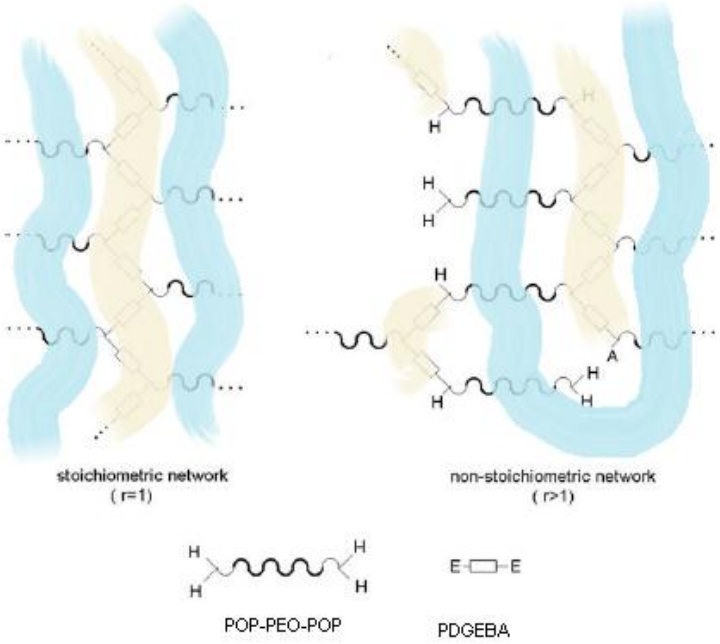




Evolving higher scale structure

Epoxy-hydrogels

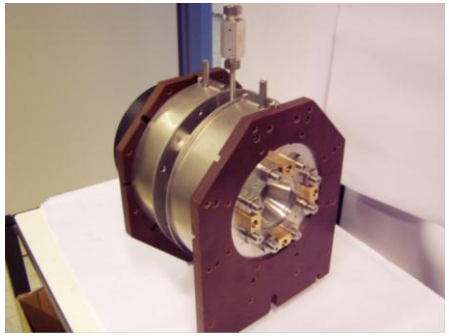
Assumed topology

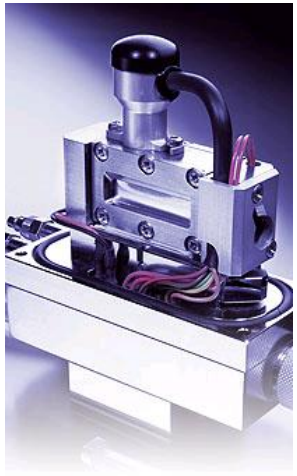


Future steps…

- Contrast matching POP-PEO-POP
- Structure ⟺ pressure
- Structure in controlled humidity and temperature

Tools…



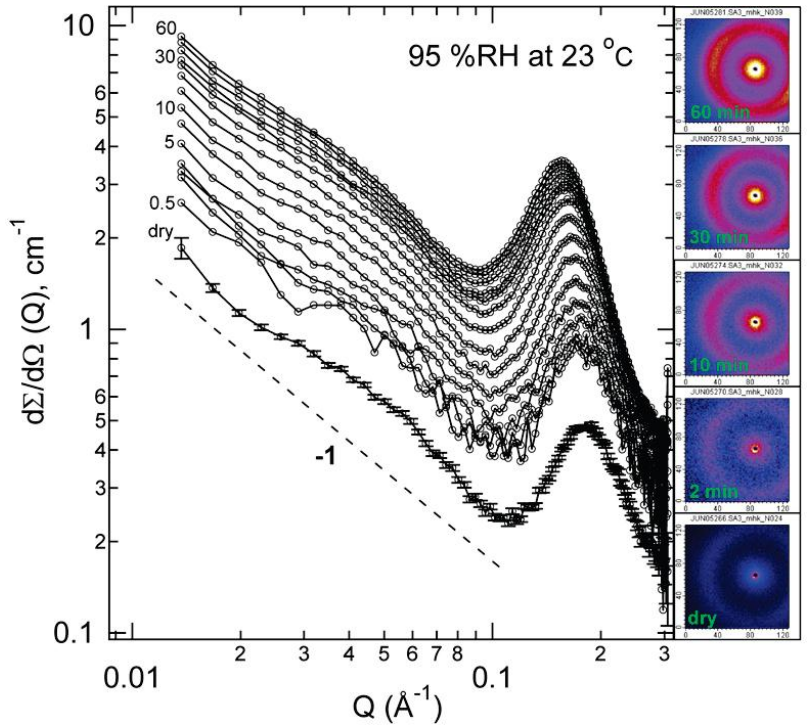


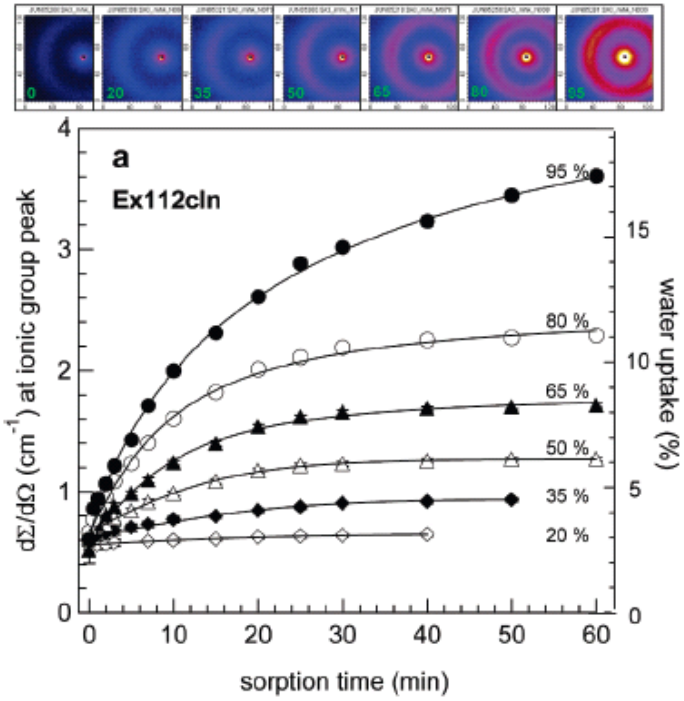
Polyelectrolyte membranes

Structural studies under controlled humidity conditions

- structural evolution with water vapor sorption (sorption isotherms)

- correlation between the interionic domain distance and the volume fractional gain of water.





Structure evolution of Nafion membrane in function of time and RH

MH. Kim et al., *Macromolecules* (39), 4775-4787, 2006

Conclusions

Small angle neutron scattering with his variety of sample environments is a versatile tool for structural characterization of matter under different external conditions.

The available high neutron intensity allows real time experiments: evolution of nano-structures in time, after the external conditions have been changed.

Using the humidity cell in the SANS study proved to be a complex approach to follow fine structural changes induced by humidity change (controlled temperature).

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Thank you for your attention!