# Smart foams: Switching reversibly between Ultrastable and Unstable foams

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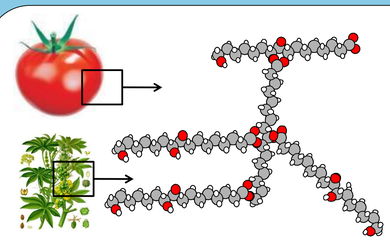
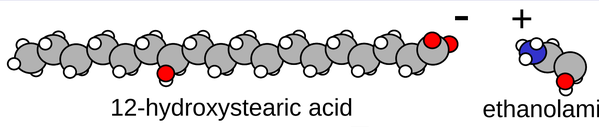
## Background & Objectives

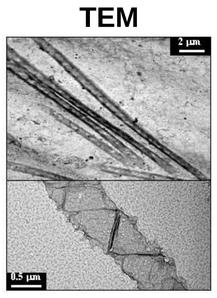


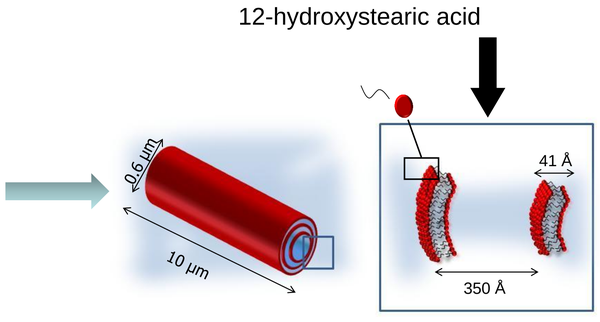
Fatty acids are surfactants of particular interest since they can be extracted from agricultural resources. However, long-chain fatty acids are generally insoluble in water at room temperature. Here, we dispersed the 12-hydroxy stearic acid using ethanolamine or hexanolamine as counter-ions. One obtains self-assembled multilayer tubes. Those tubes melt into micelles at a temperature that depends on the nature of the counter-ion. Together with interfacial studies, one of the aims of this work is to determine if foams can be made from such fatty acid solutions, and what are the properties of these foams. We showed that these foams are ultrastable at room temperature and strongly thermoresponsive.

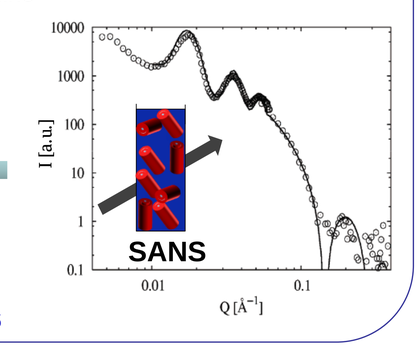
## System: bulk studies



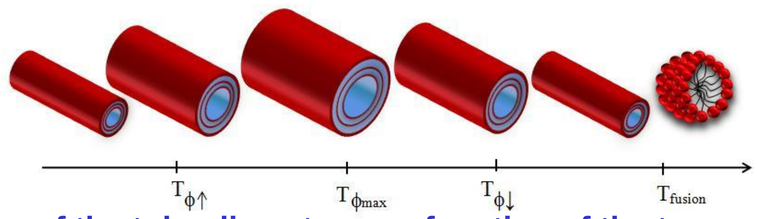

TEM



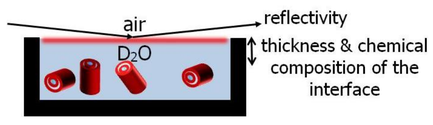

**Self-assembled multilamellar tubes**

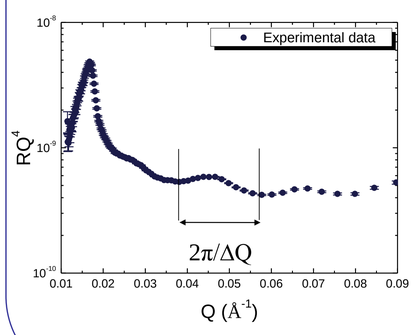



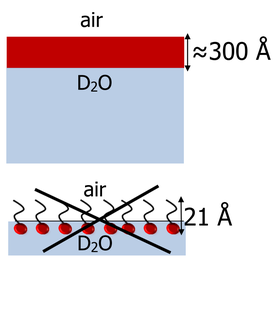

- **Evolution of the tube diameter as a function of the temperature**
- **Thermoresponsive supramolecular assembly: transition between tubes (10 µm in length) and micelles (4 nm in diameter)**

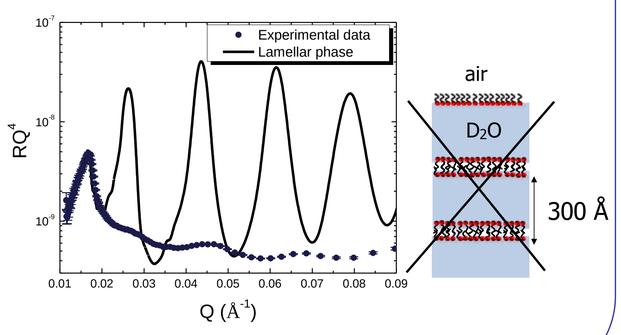
## Interfacial studies: Adsorption of tubes at the air/water interface?

### Neutron reflectivity



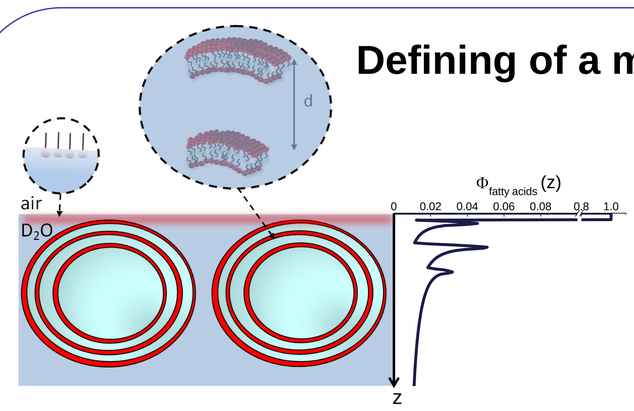



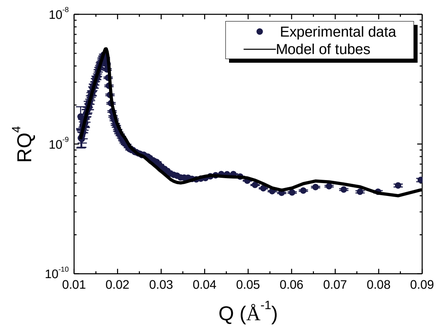




**The data cannot be fitted with monolayer or lamellar phases.**

### Defining of a model



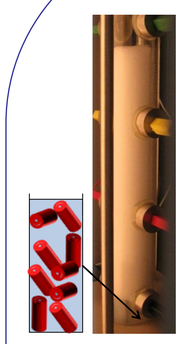



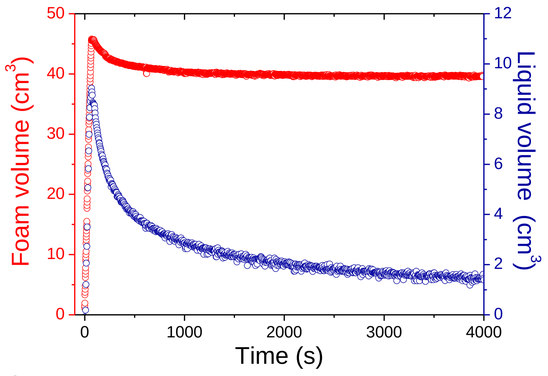

- **Adsorption of tubes at the interface below a fatty acid monolayer!**
- **Fatty acids monomers form an insoluble layer at the interface.**

## Foam studies: how tubes can stabilize foams?

Fameau A.L. et al., Angewandte Chemie International Edition, doi.org/10,1002/anie.201102115.

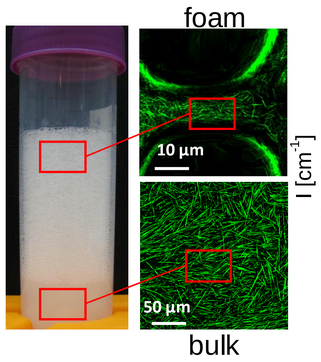
### Characterization of foaming properties at 25°C

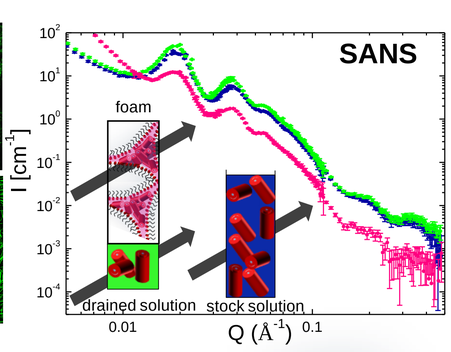




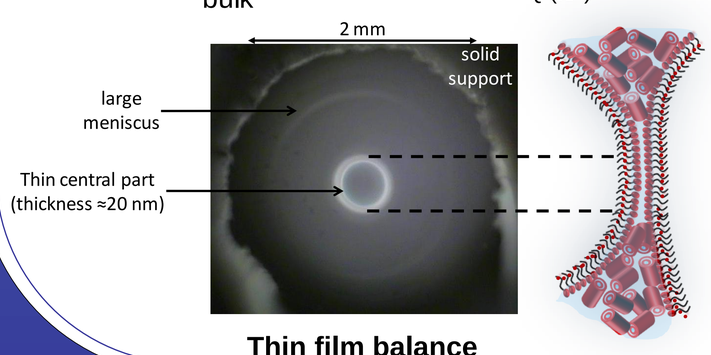


Ultrastable foam!




**Tubes in the foam exhibit similar structural parameters as in the stock solution!**

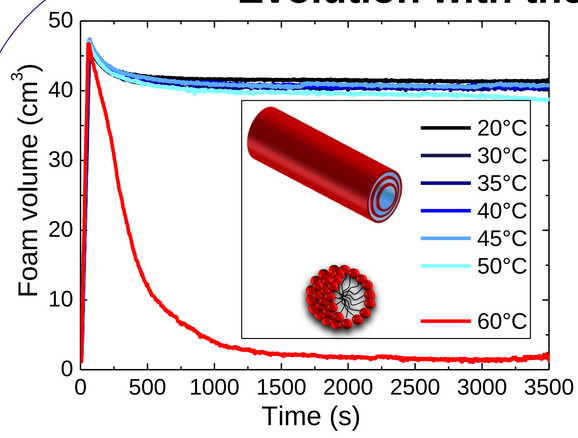


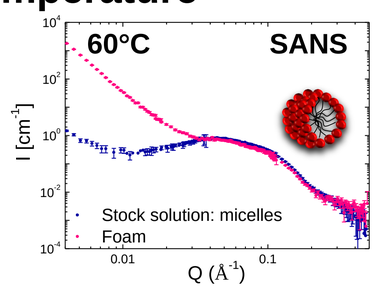

**Thin film balance**



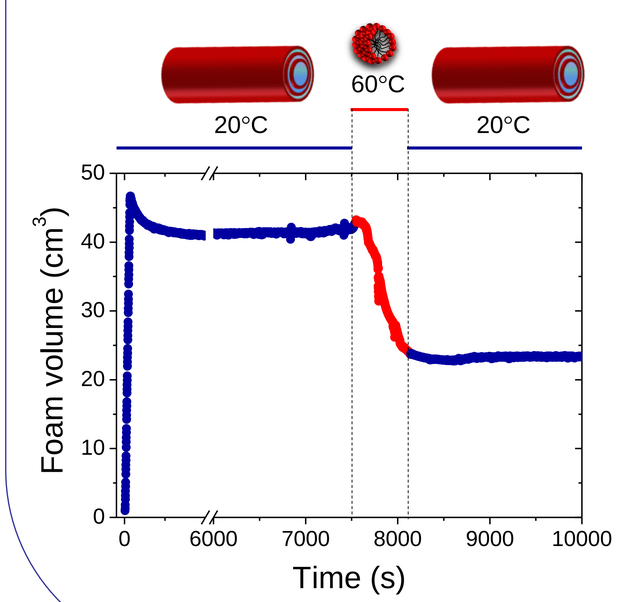
- **Only free monomers of 12-hydroxystearic acid stabilize the thin central part of the lamellae.**
- **Tubes accumulate and are jammed in the surrounding meniscus and in the Plateau borders.**

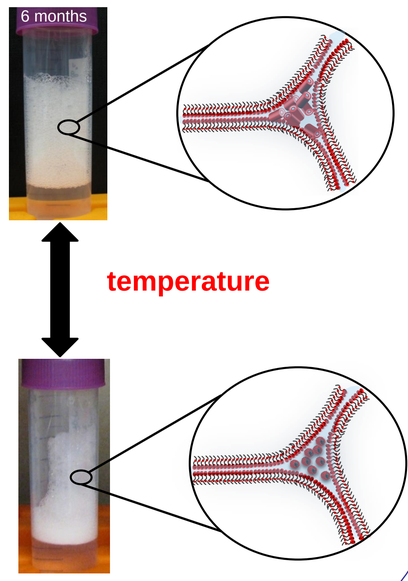
### Evolution with the temperature




**Upon heating, tubes transit to micelles in the foam leading to very fast foam destabilization!**




Foams exhibit temperature-tuneable stability!

## Conclusion

- **Ultrastable foams with an optimal foamability are obtained using fatty acids multilamellar tubes.**
- **Upon heating tubes transit to micelles, leading to very fast foam destabilization and thus to the first foams to exhibit strong and reversible temperature-tuneable stability.**

## References

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