Computational Mechanics Group
Prof. Dr. Laura De Lorenzis
www.compmech.ethz.ch

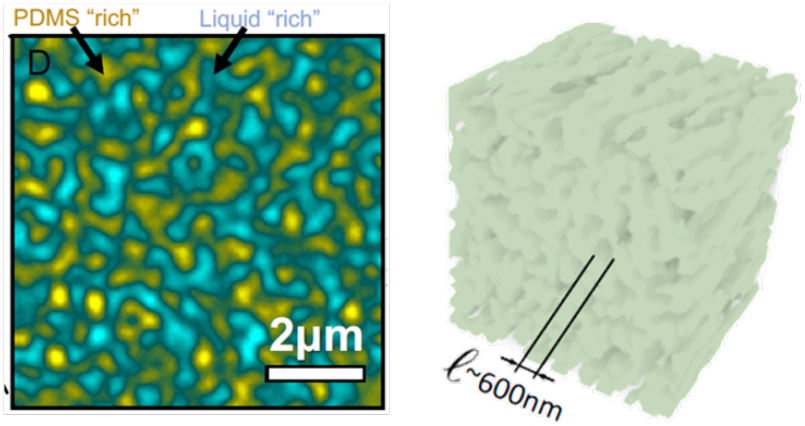
Topic proposal

Coupling mechanics with spinodal decomposition phenomena

Spinodal decomposition is a process where a homogeneous mixture is thermodynamically unstable, and for this reason it separates into two or more stable phases. This is often seen in metal alloy or polymer blends. Microstructures generated by spinodal decomposition result in fascinating mechanical, acoustic and optical properties, among others. However, controlling the spatial correlation of these microstructures remains a challenging task. One current investigated approach is to mechanically control and arrest spinodal decomposition through phase separation in monitored stiff elastic cross-linked polymer networks.

Our task is to formulate a model and to set up the related computational framework to simulate spinodal decomposition and the effect of the polymer deformation on the final morphology. The model will then suggest which parameters should be tuned to arrest the spinodal decomposition and reach a desired morphology; e.g. the stiffness of the polymer, the diffusivities of the species etc. The model predictions will then be verified experimentally.

a. Spinodal decomposition in cross linked polymer



b. FEM simulation of spinodal decomposition

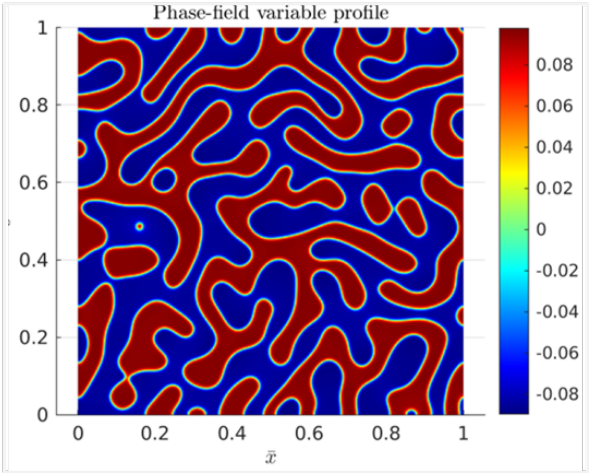


Figure: a. Experimental* and b. simulated spinodal decomposition in cross-linked polymer

*Source: Fernández-Rico et al., (2021), *Putting the Squeeze on Phase Separation*, JACS Au. https://doi.org/10.1021/jacsau.1c00443

Contact
Hamza Oudich
Tannenstrasse 3, CLA J 17.2
E-mail: houdich@ethz.ch