Phase separated structures of concentrated polymer solutioons

Patrick Guenoun, Hervé Manzanarez, Hernan Garate, Denis Bouyer, Andre Deratani, Catherine Faur, Mathieu Jacob, Jean-Pierre Mericq, Olivier Lorain, Catherine Pochat-Bohatier

PHASE SEPARATED STRUCTURES OF CONCENTRATED POLYMER SOLUTIONS

Patrick GUENOUN[1], Hervé MANZANAREZ[2], Hernan GARATE[1], Denis BOUYER[2], André DERATANI[2], Catherine FAUR[2], Mathieu JACOB[3], Jean-Pierre MERICQ[2], Olivier LORAIN[4], Catherine POCHAT-BOHATIER[2]

[1]*Université Paris-Saclay, LIONS, CEA Saclay, 91191 Gif sur Yvette cedex*

[2] *IEM (Institut Européen des Membranes) UMR 5635 (CNRS-ENSCM-UM2), Université Montpellier, Place Eugène Bataillon, F-34095 Montpellier, France*

[3]*Total, Pôle d'étude et de recherche de Lacq, Pôle économique 2, BP 47 – 64170, LACQ, France*

[4] *Polymem - 3 rue de L'industrie - Zone de VIC, 31320 Castanet-Tolosan - France*

Phase separation of concentrated homopolymer solutions is both of fundamental interest (the large difference in viscosity/elasticity of the two phases can lead to unusual behaviors) and of practical importance (novel porous structures can be made by this process). I will first review how 2D phase-field simulations (Fig.1) reveal the influence of the mobility dependance with concentration for capturing features of phase separation like growth laws.[1] On the experimental side I will examine various water-soluble polymers and show how anomalous phase diagrams seem to be closely connected to unusual features of arrested-like phase separation as evidenced by light scattering and confocal microscopy. Thin films of these polymer solutions were used for making membranes (Fig. 2), avoiding the use of organic solvents. [2, 3, 4] The case of homo-polyelectrolytes is also of great interest since the theory is still controversial, as I will briefly recall. First results will be presented about phase separation upon changes in salt concentration, polymer concentration and temperature for a polyelectrolyte whose structure is also promising for membranes.

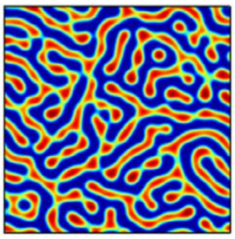

Figure 1 – 2D Simulation of phase separation in polymer solution

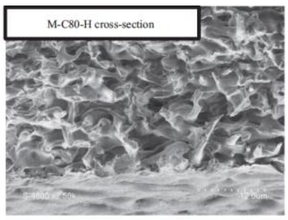

Figure 2: Membrane made by phase separation of a PVA solution

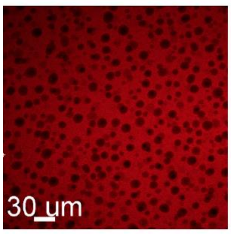

Figure 3: Confocal image of a phase separating polyelectrolyte

References

[1] Manzanarez H. Mericq, J. P.; Guenoun, P.; Chikina, J. & Bouyer, D., *Chemical Engineering Science*, **2017**, *173*, 411-427

[2] M'Barki O. Hanafia, A.; Bouyer, D.; Faur, C.; Sescousse, R.; Delabre, U.; Blot, C.; Guenoun, P.; Deratani, A.; Quemener, D. & Pochat-Bohatier, C. al., *Journal of Membrane Sscience*, **2014**, *458*, 225-235

[3] Hanafia A. Faur, C.; Deratani, A.; Guenoun, P.; Garate, H.; Quemener, D.; Pochat-Bohatier, C. & Bouyer, D., *Journal of Membrane Science*, 2016, *526*, 212-220

[4] Bouyer D. M'Barki, O.; Pochat-Bohatier, C.; Faur, C.; Petit, E. & Guenoun, P *AICHE Journal*, **2017**, *63*, 3035-3047