Photo cross-linked and pH sensitive polymersomes - nanoreactor and membrane studies

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As part of the constant effort in science to mimic nature, amphiphilic block-copolymers were found to vesicles composed of a bilayer membrane. These so-called Polymersomes have proven to be suitable for synthetic biology such as drug delivery or nanoreactors. Compared to their biological counterpart, the liposomes, their membrane is considerably thicker and shows increased mechanical and chemical strength. This strength can yet be improved by introducing chemical bonds within the membrane, e.g. to crosslink it.[1] We combine membrane crosslinking on a photochemical basis with a pH sensitive polymer to give highly stable polymersomes with controlled permeability. Essentially, the transmembrane diffusion of these vesicles can be controlled by pH and the shear rate applied, which eventually lead us to the formation of a synthetic bionanoreactor.[2]

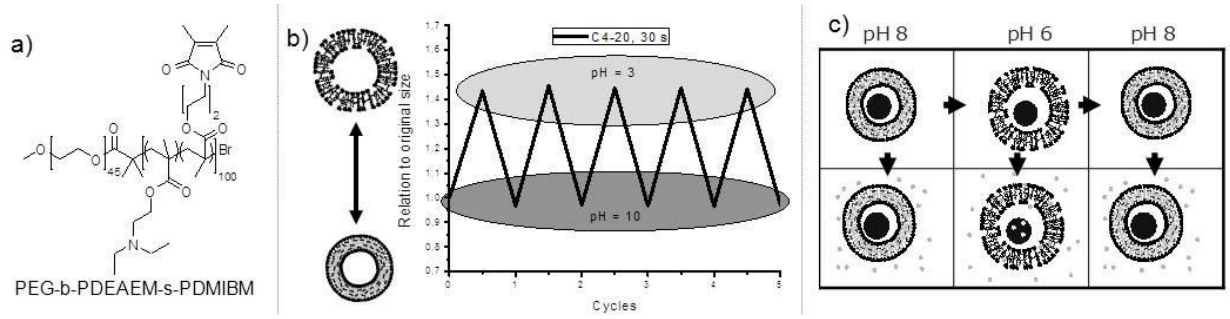

Figure 1. (a) PEG-b-PDEAEM-s-PDMIEM block-copolymer used to form polymersomes. (b) Reversible, pH cotrolled swelling behaviour. (c) Synthetic bionanoreactor allowing for reactions at an acidic state only.

Besides the possibility to make nanoreactors, this system also allows for a closer analysis of the membrane itself – as it is usually done for liposome membranes. Once spreaded on a Si wafer, we were able to cross-link the membrane once again and show significant changes in its mechanical properties upon cross-linking and a change in pH in terms of height and rigidity of the membrane. A combined analysis with AFM and confocal microscopy gave a deep insight into the mechanics of these vesicle-forming membranes.[3]

[1] J. Gaitzsch, D. Appelhans, D. Graefe, P. Schwille and B. Voit, *Chem. Commun.*, 2011, 47, 3466-3468
[2] J. Gaitzsch, D. Appelhans, L. G. Wang, G. Battaglia and B. Voit, *Angew Chem Int Edit*, 2012, 51, 4448-4451
[3] J. Gaitzsch, D. Appelhans, A. Janke, M. Strempel, P. Schwille and B. Voit, *Soft Matter*, 2014, 10, 75-82