Master project 2021-2022

Hydrophobic polyelectrolytes: Effect of chain architecture

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Hydrophobic polyelectrolytes are a class of pH-sensitive polyelectrolytes containing both hydrophobic and ionizable chemical groups, which present sharp coil to globule (extended to collapsed) transitions [1] (fig 1). They are also known to penetrate and solubilize cell membranes [2,3]. This range of properties allows for a variety of applications such as chemical and biological sensing [4], targeted drug delivery into tissues with pH gradients, such as cancerous tissue [5], and solubilization of cell membranes allowing for the characterization of proteins in their native environment [3]. Recently we have observed that this class of polymer can act as an excellent emulsifier of oil and water phases.

In this project we are interested in elucidating what the effect of changing the polymer architecture is on the properties of these polymers. Specifically, the role of having the ionizable and hydrophobic groups on separate freely rotating units versus the groups being on the same unit (fig 2).

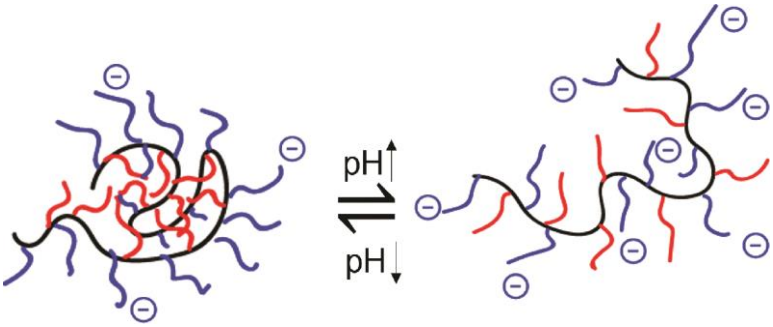

Figure 1: pH driven coil to globule transition. Blue lines represent ionizable groups and red lines represent hydrophobic groups.

The project will involve synthesis of the polymers and then investigation of their properties with respect to emulsification, membrane solubilization/penetration, and oil/water partitioning. A range of techniques including RAFT polymerization, dynamic light scattering, spinning drop tensiometry and UV-Vis adsorption spectroscopy will be used throughout the project.

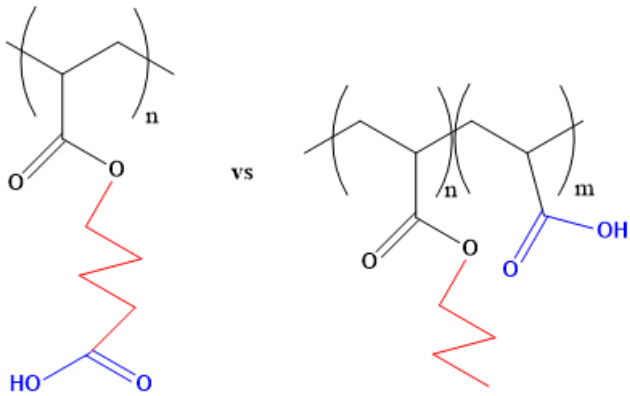

Figure 2: Diagram of the 2 possible different arrangements of the ionizable and hydrophobic groups.

This work will lead to a better understanding of the mechanisms of the phenomena that hydrophobic polyelectrolytes are involved in and therefore afford guidelines on the design of application specific polymers.

References:

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[3] J.M. Dörr, S. Scheidelaar, M. C. Koorengevel, J. J. Dominguez, M. Schäfer, C. A. van Walree, C. and J. A . Killian, *European Biophysics Journal* **45**, 3-21 (2016)
[4] Y. Li, T. Zhao, C. Wang, Z. Lin, G. Huang, B. D. Sumer and J. Gao, *Nature Communications* **7**(1), 1–11 (2016)
[5] F. Reyes-Ortega, Smart Polymers and their Applications, Chapter 3, 45–92, *Woodhead Publishing* (2014)