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Lecturer in Polymer and Physical Chemistry

8 September 2017

### **End of Year Report for the 2016 University of Sydney Selby Research Award**

**Project:** Cellulose-based polymer nanorods

**Summary:** This project focusses on the investigation of rod-like and stiff polymer nanoparticles with cellulose components. We seek to develop a novel platform – centred on our in-depth expertise on cylindrical polymer brush nanoparticles – to produce tailored polymeric nanorods with enhanced tumor tissue penetration.

**Findings:** We developed a facile methodology to produce anticancer drug-loaded polymer nanorods and tested their ability to kill breast cancer cells *in vitro* (reference 1). We made impactful progress in the investigation of the aspect ratio-dependant penetration of polymer nanorods in colon cancer cells tissue (manuscript in preparation). We successfully translated our knowledge on molecular brushes to develop stiff polymer nanorods based on cellulose nanocrystals and are currently investigating their behaviour *in vitro*. Meanwhile, we have used our cellulose-based nanorods to produce highly porous hybrid materials (reference 2, manuscript submitted).

**Budget spending:** Funding was requested to develop technical and practical expertise in cellulose nanocrystal handling. This was made possible through a six-week research visit to Aalto University in Finland (July-August 2017) – as part of this Award. In addition, the Award aided the advancement of the investigation of our polymer nanorods through *in vitro* cell and tumor experiments as well as electron and fluorescence microscopy.

**Communication of results:** **1)** T. Pelras, H.T.T. Duong, B.J. Kim, B.S. Hawkett, M. Müllner: 'A 'grafting from' Approach to Polymer Nanorods for pH-Triggered Intracellular Drug Delivery' *Polymer* 2017, 112, 244. **2)** M. Morits, V. Hynninen, Nonappa, O. Ikkala, A.H. Gröschel, M. Müllner: 'Hollow silica nanorods from well-defined sustainable cellulose templates' submitted. **3)** M. Müllner: 'Molecular Polymer Brushes in Nanomedicine' *Macromol. Chem. Phys.* 2016, 217, 2209. **4)** M. Müllner, A.H.E. Müller: 'Cylindrical Polymer Brushes – Anisotropic Building Blocks, Unimolecular Templates and Particulate Nanocarriers' *Polymer* 2016, 98, 387.

**Invited conference/seminar contributions** (where the results were communicated):  
2017: European Polymer Congress (Lyon, France), Soft Matter Materials Symposium (QUT, Australia), HYBER seminar at School of Applied Physics (Aalto University, Finland), Physical Chemistry colloquium (University of Duisburg-Essen, Germany), School of Chemistry Seminar (UNSW Australia)  
2016: 36th Australasian Polymer Symposium (Lorne, Australia), Emerging Polymer Technologies Summit (Melbourne, Australia)

*"We thank the Selby trustees for their support of our research. These funds have been extremely useful, and allowed us to generate high-quality preliminary data, which will support future large funding applications, specifically, ARC Linkage grants."*