Online capsule formation by consecutive adsorption of fluorescent polyelectrolyte in a microfluidic network

Craig Priest¹, Almar Postma², Brigitte Städler², John Ralston¹, and Frank Caruso²

Background
Microfluidic processing is rapidly transforming the way we handle high value, small volume samples. Within tailored microchannel networks, precise aliquots of liquids can be dispensed, combined, rapidly mixed, and analysed downstream[1]. Polyelectrolyte microcapsules are prepared through consecutive adsorption of multiple layers[2], which is a batch process involving sequential adsorption and washing steps. In this work, we are using microfluidic flow for the synthesis of highly monodisperse polyelectrolyte microcapsules under continuous flow conditions. Using fluorescently labelled polymers and fluorescence microscopy, we can follow the adsorption and rinse sequences in the microchannels, and characterise the microcapsules off-line.

Outcomes:
• Alternative method for the synthesis of polyelectrolyte microcapsules
• Improved monodispersity of microcapsules for drug delivery
• Reduction of high-value materials (drug), multilayer adsorption time, and handling

Progress to date.
• Monodisperse microcapsules can be assembled using a tailored microfluidic chip
• Fluorescence microscopy of the process and capsules shows that on-chip rinse efficiencies are sufficient to assemble multilayers, which resemble those prepared using bulk methods
• Microfluidic multilayer assembly time (for 3 layers) is < 2 min

Fluorescence micrographs of (a) the infusion of the fluorescently labelled polymer, (b) the infusion of the rinse solution; infusion channels are outlined for clarity and scale bars are 200 μm, (c) microcapsules after removal from the microchip; scale bar is 50 μm, and (d) confocal microscopy of the labelled multilayer.

Contacts:
1. University of South Australia
   Microfluidics: Dr. Craig Priest, craig.priest@unisa.edu.au
2. The University of Melbourne
   Microcapsules: Prof. Frank Caruso, fcaruso@unimelb.edu.au

References: