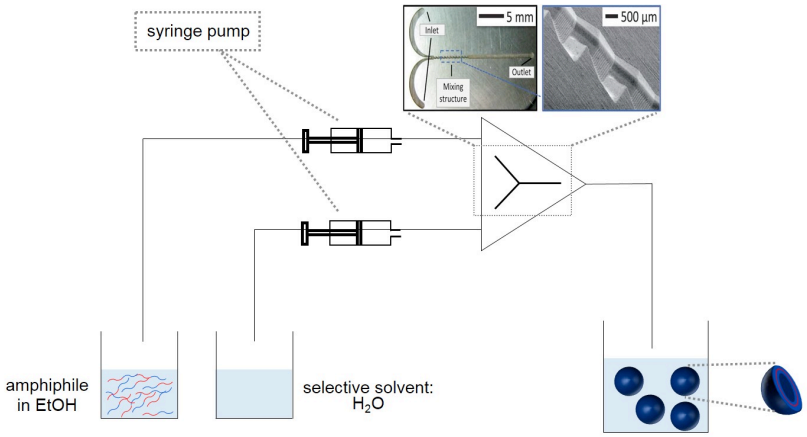
Controlled self-assembly of Janus dendrimers via microfluidics

Soraya Taabache[1,2], Michael Maskos[1], Annabelle Bertin[2,3]

[1]*Fraunhofer ICT-IMM, Mainz, Germany*
[2]*German Federal Institute for Materials Research and Testing (BAM), Dpt. 6. Materials Protection and Surface Technology, Berlin, Germany*
[3]*Freie Universität Berlin, Institute of Chemistry and Biochemistry, Berlin, Germany*
Annabelle.Bertin@bam.de

Vesicles self-assembled in water from natural and synthetic phospholipids (liposomes), amphiphilic block copolymers (polymersomes), and more recently amphiphilic Janus dendrimers (dendrimersomes)[1-5] as hollow soft structures in the nano size regime have attracted increasing interest as they can mimic primitive and contemporary biological membranes, and can be configured into biomimetic nanocapsules with application in nanomedicine such as gene, proteins and drug carriers or theranostics.
Compared to other amphiphilic structures, the molecular structure of Janus dendrimers can be precisely controlled: by using the vast range of tools from organic chemistry their size, architecture, density, generation as well as the number of end groups of the individual dendrons can be modified as desired.
Unfortunately, the controlled production of the supramolecular aggregates made thereof is still a challenging task. Conventional batch-based techniques such as the solvent injection method or the film hydration method typically go along with a lack of control over mixing and thus over size, morphology and size distribution. The micromixer technology is a promising method for the controlled preparation of supramolecular assemblies as it allows control of mixing at microscale level. In addition, such microfluidic systems benefit from a high mixing efficiency, a low mixing time as well as from a reproducible and continuous synthesis.
Herein, we report on the microfluidic-controlled self-assembly of Janus dendrimers as dendrimersomes and the impact of the mixing parameters on the self-assembly process.



Schematic illustration of the continuous microfluidic-controlled self-assembly of dendritic amphiphiles.

[1] M. Peterca, V. Percec, P. Leowanawat, A. Bertin, *J. Am. Chem. Soc.* **2011**, *133*, 20507-20520.
[2] V. Percec, P. Leowanawat, H.-J. Sun, O. Kulikov, C. Nusbaum, T. M. Tran, A. Bertin et al., *J. Am. Chem. Soc.* **2013**, *135*, 9055-9077.
[3] S. Zhang, H.-J. Sun, A. D. Hughes, R.-O. Moussodia, A. Bertin et al., *Proc. Natl. Acad. Sci. U.S.A.* **2014**, *111*, 9058-9063.
[4] S. Zhang, H.-J. Sun, A. D. Hughes, B. Draghici, J. Lejnieks, P. Leowanawat, A. Bertin et al., *ACS Nano* **2014**, *8*, 1554-1565.
[5] S. Taabache, A. Bertin, Vesicles from amphiphilic dumbbells and Janus dendrimers: Bioinspired self-assembled structures for biomedical applications, *Polymers* (invited review in special issue "Bio-inspired and Bio-based Polymers"), submitted.