All-aqueous core-shell emulsions by microfluidics

I. Ziemecka1*, V. van Steijn1, G.J.M. Koper1, M.T. Kreutzer1 and J.H. van Esch1

1 Delft University of Technology, Department of Chemical Engineering, Julianalaan 136, 2628BL Delft, The Netherlands
* e-mail: i.ziemecka@tudelft.nl

We present the method to create all-aqueous core-shell emulsion in a microfluidic device. This three-phase system could be obtained by the use of aqueous solutions of polymers such as dextran and polyethylene glycol (PEG) which are known to phase separate.

Previously we presented a method to controllably and reproducibly form monodisperse hydrogel microspheres from water-in-water droplets with a diameter range between 30 to 60µm in a microfluidic reactor by destabilizing an ATPS laminar flow by low frequency mechanical oscillations (20-50Hz) [1]. We showed experimentally and explained theoretically that the droplet size can be controlled by the actuation frequency of the piezoelectric disc embedded in our device and the flow rates at which the aqueous solutions are supplied. Subsequent on-chip polymerization of the droplets yielded stable hydrogel particles.

Here we present a new microfluidic approach, where low frequency and high amplitude mechanical oscillations of a piezoelectric disc causes the creation of core-shell microdroplets where the shell is an aqueous dextran solution and the core an aqueous PEG solution. This system can be used for the production of core shell particles with high encapsulation efficiency in all-aqueous environments.