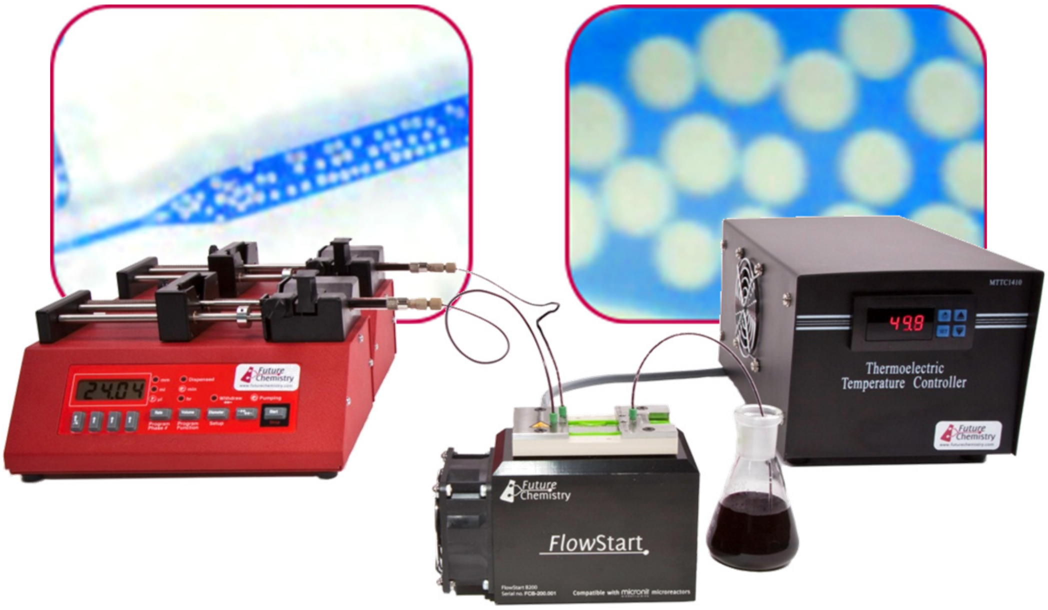
Application Note 4.1

Droplet generation



Chemical processes occurring on the fluid/fluid interface can be studied and enhanced by means of efficient droplet generation. An increasing demand is emerging for effortless microdroplet generation. In response to this demand, the viability of our common *Flow*Start B-200 hardware to be used as microdroplet generator has been analysed by FutureChemistry.

Future Chemistry

Introduction

In contrast to homogeneous reaction mixtures, some reactions can also be carried out on the liquid-liquid interface, offering large increase in rate and/or greatly facilitating work-up through phase transfer of the synthesised product. One example is the cleavage of esters at the toluene/water interface, thereby enhancing the reaction rate while continuously extracting the product into the water phase. From this is follows, that a large interfacial area is crucial to reaction speed-up. In batch, droplets can be generated through mechanical stirring. However, continuous flow offers the added advantage of precise control over droplet size and diameter distribution.

This *application note* describes the generation of droplets of an organic phase in an aqueous phase in a small scale process using the *Flow*Start and the short quench microreactor.

Droplet Generation

Droplets are generated in a split and recombine mixer, by continuously breaking down a segmented plug flow of toluene in water. The flow setup, used for demonstrating the viability of creating droplets in a microreactor, is depicted in Figure 1.

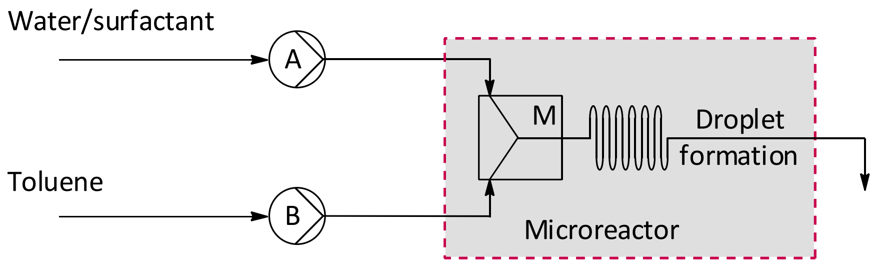


Figure 1: *Flow*Start setup

Important for droplet generation is control over size distribution. Upon using a common split and recombine mixer, droplet size is mainly determined by the channel width and the number of mixing sections. Varying the flow rates and flow rate ratio over a wide range did not significantly alter the droplet's diameter.

A size distribution was determined on a droplet diameter centred on 90 micrometers, corresponding to a volume of 0.7 nanoliter.

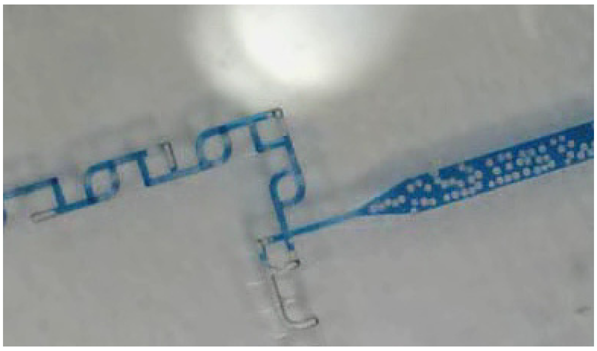


Figure 2: Droplet generation in microreactor

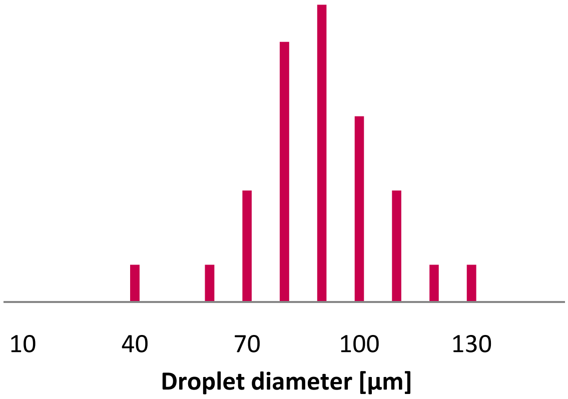


Figure 3: Typical droplet size distribution

Method

All experiments were conducted in a standard FutureChemistry *Flow*Start B-200 setup, using the M-130 short quench microreactor with internal volume of 1.0 µL. The channel's glass surface was cleaned by rinsing the microreactor with 1 M NaOH for 1 minute with flow rate of 10 µL/min.

Solution A: Potassium laurate based surfactant (1% v/v) in water; coloured with common food dye

Solution B: Toluene

Two glass 1.0 mL syringes were loaded with solutions A and B respectively. For each experiment, the desired flow rates were set to 0.1-10 µL/min, with flow ratio A/B in the range 1 to 10.