

ABSTRACT

The application of tube-based microfluidic technology is very promising for the investigation of toxicological studies on microorganisms. A newly developed 6-port manifold was characterized for the precise concentration adjustment inside nanoliter droplets. The droplet generator made of PTFE and PCTFE material is of modular design, so that different droplet sizes from 180 nL up to 1.8 μ L can be generated. A total of eighteen different diameter combinations were tested by the generator under three different flow rate combinations. The dependence of the droplet quality on the viscosity of the aqueous phase was also investigated. The results show that newly developed droplet generator could generate droplet sequences precisely but PCTFE droplet generator needs further treatment after a long run time program. The flow rate of the continuous phase and dispersed phase, and viscosities of aqueous phase particularly did not affect the quality of the droplet generated. This newly developed manifold not only enables highly resolved dose-response screening for single substances, but also shows a higher resolution of 2D and 3D concentration spaces compared to commercially available manifolds.

The multi-channel microflow-through photometric and fluorimetric measurement allows monitoring of the droplet size, droplet spacing, dye distribution in whole droplet sequence and the growth as well as the autofluorescence of microorganism. The applications of this microfluidic system were used for determining the growth kinetics of cyanobacteria *Synechococcus elongatus* UTEX 2973 and *Synechocystis* sp. PCC 6803 and observe the dose-response screening against NaCl, glucose and NaHCO₃.

Overall, this system offers a wide range of applications, such as highly resolved dose-response screening, Media conditioning for the cultivation of microorganisms, multi-dimensional spaces for screening combined effects and the analysis of high amounts of well isolated μ L and nL culture volumes.