Loughborough University

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Lego Inspired Glass Capillary Microfluidics

Novel device for robust, systematic and cost-effective droplet generation & screening

Please note, header image is purely illustrative. Source: Science Photo, stock.adobe.com

IP Status

Patent application submitted

Seeking

Development partner, Commercial partner

About **Loughborough University**

Loughborough University is proud of its long history as an institution of further and higher education and of its focus on Enterprise and engagement with industrial partners alongside Research and Teaching.

Background

Drop-based microfluidics is a rapidly growing key technology for generation of monodispersed droplets and capsules with tuneable morphology with end-use properties for drug-delivery, medical imaging, sensing, chemical screening amongst many other applications. However, current microfluidic systems are costly, permanently bonded, difficult to clean and in some cases laborious and time consuming to make. In addition to the above, crystallisation is one of the other main applications which this device can add valued to. With more than 80% of pharmaceutical and related products requiring at least one crystallisation step as a key purification and isolation process, ensuring consistent crystal purity, shape and size distribution are critical. Current crystallisation development and screening can be laborious, costly and time-consuming – subject to challenges that hinder the systematic implementation of effective design of experiment (DoE).

Tech Overview

Current devices bond glass capillaries to microscope slides, with fluids introduced via hypodermic needles. The set-up is fixed and does not always provide accurate or consistent results – nor are they reusable.

This device comprises two Lego-inspired blocks into which the capillaries can be easily inserted and overcomes the above problems and offers a reliable and cost-effective solution that provides consistent results every time (Figure 1). This facilitates rapid assembly for work, and easy dismantling for cleaning. In addition, the blocks provide the flexibility to carry out precise and information-rich screening experiments. Its design also supports three flow configurations:

- co-flow
- counter-current flow focusing
- a combination of co-flow and counter-current flow focusing

Additionally, it can be scaled up to consistently produce high-quality, high-value products, including crystals.

These features make them an attractive proposition for research laboratories and pharmaceutical manufacturers alike.

Stage of Development

The device has been tested and proved effective under different configurations through various applications, including crystallisation.

Benefits

This new device offers a number of benefits, and interest within the research community is growing.

- User-friendly design, reusable glue-free device: The microfluidic device is robust and reusable. It is easy to set-up, dismantle, clean and reassemble. The device is reconfigurable to achieve different flow and micro-mixing conditions.
- Automatic alignment of capillaries
- Axisymmetric geometry
- Perfect for quick microfluidic emulsification, crystallisation and particle formation tests
- Single-step multiple emulsion droplet generation
- Consistent results, precise screening and effective DoE

A reliable tool for systematic screening of crystallisation chemicals, recipes, supersaturation levels, polymorphisms, crystal size and shape distribution – it facilitates the implementation of dynamic and complex DoE through one single information-rich experiment.

- Cost-effective and environmentally friendly

Full screening and investigation for scale up studies can be wasteful and expensive. Our device produces crystals with finely tuned quality attributes on demand, resource-efficiently and cost effectively, and the device can be scaled out.

Applications

Drug-delivery, medical imaging, sensing, chemical screening, Crystallisation.

Patents

- PCT Patent filed.

Appendix 1

Figure 1