# MICROFLUIDIC DEVICE WITH REMOVABLE CAPILLARIES

## IITM Technology Available for Licensing

### Problem Statement

- Conventional bulk emulsification creates polydisperse emulsions, affecting stability, texture, appearance and shelf life. Monodisperse emulsions with narrow droplet distribution offer better stability.
- Microfluidic approaches enable monodisperse emulsions; however, existing devices struggle with solvent compatibility, ease of adjustments, and cost-effectiveness of fabrication.
- Current glass capillary microfluidic devices face issues like solvent incompatibility and require use of adhesives while being expensive with complex fabrication tools for capillary adjustments.
- There is a need for a glass capillary microfluidic device that is solvent-compatible, easily adjustable, with easy replacement of clogged capillaries while being economic to fabricate.

### Intellectual Property

- IITM IDF Ref 2496
- **IN 457547 Patent Granted**

### TRL (Technology Readiness Level)

**TRL 4 Technology Validated in Lab**

### Technology Category/ Market

**Category- Micro & Nano Technologies**

**Industry Classification:**

Pharmaceuticals; Food & Beverages; Cosmetics

**Applications:**

Controlled drug release, particularly in formulations with drugs like Metformin ; creams, lotions, and other emulsions where consistency and particle size control are critical ; Microencapsulation for Agricultural Products ; controlled-release formats, enhancing the efficacy and reducing environmental impact

**Market report:**

Microfluidic Droplet Generator Market was valued at USD 1.2 Billion in 2023 and is projected to grow to USD 3.5 Billion by the end of 2030 with a CAGR of 17.5%

### Research Lab

**Prof. Raghunathan Rengaswamy**
Dept. of Chemical Engineering

**Prof. Basavaraja Madivala Gurappa**
Dept. of Chemical Engineering

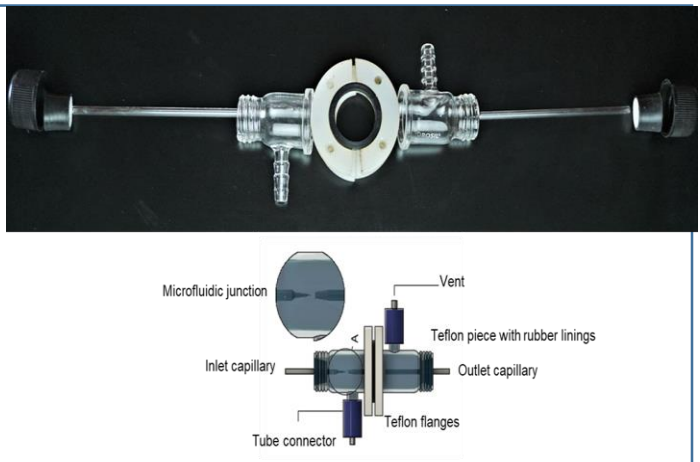


**Figure:** Photograph of the components of the modular microfluidic device and a schematic illustrating the device.

**Figure:** Photograph of assembled glass microfluidic device.

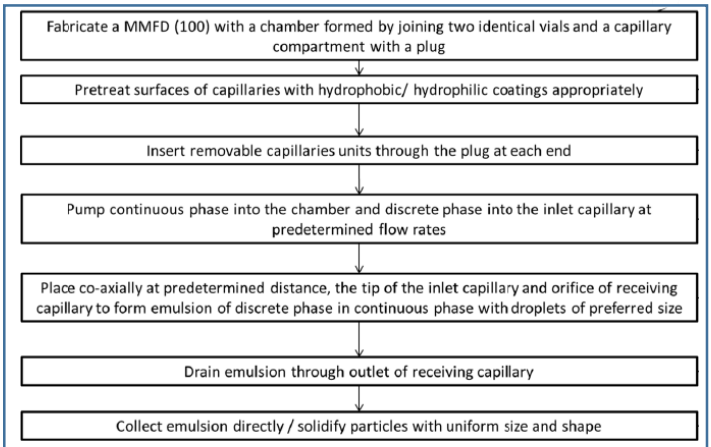


**Figure:** An illustration of a method of preparing a mono-disperse emulsion using a modular microfluidic device

**CONTACT US**
**Dr. Dara Ajay, Head TTO**
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

**IITM TTO Website**:
https://ipm.icsr.in/ipm/

**Email**: headtto-icsr@icsrpis.iitm.ac.in
tto-mktg@icsrpis.iitm.ac.in
**Phone**: +91-44-2257 9756/ 8369

**Figure:** Photograph of micro-droplet generation at the microfluidic junction of the microfluidic device.

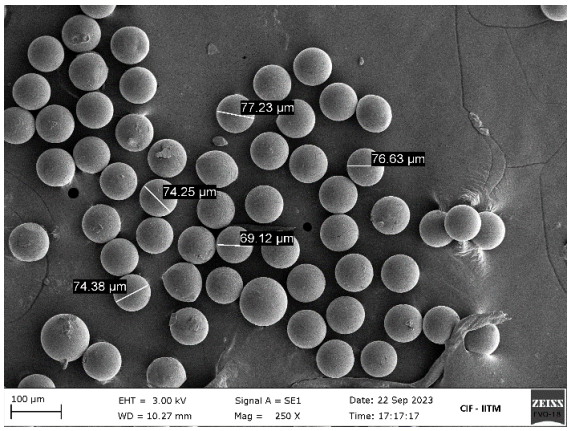


**Figure:** SEM image of micro-particles at 250X magnification.

## Technology

- The technology uses detachable capillaries to form a modular microfluidic setup, where the spacing between the inlet capillary and the receiving orifice can be adjusted to control the size of emulsified droplets.
- The spacing between the micro-capillary tip and the receiving orifice is adjustable, allowing precise control over droplet size in emulsions, tailored to specific application needs.
- The device includes a leak-proof joining unit with elastomeric seals, ensuring efficient, contamination-free operation and ease of disassembly for maintenance and cleaning.
- Droplet size in microfluidic emulsions is influenced by fluid flow rates, microchannel geometry, and fluid properties. Fine-tuning flow rates controls droplet size, with uniform particles (80–90 µm) formed by controlling flow rate ratios and geometry.
- In the water-glycerol and silicone oil system, droplet size decreases with higher continuous-phase flow and lower discrete-phase flow, highlighting the importance of precise flow control for consistent emulsion particle formation.
- Fabricated from low-cost materials like glass and Teflon, the device is durable, reusable, and easy to manufacture in basic facilities, offering significant cost advantages over high-precision alternatives

## Key Features / Value Proposition

- The device features detachable capillaries for easy adjustments and replacements, allowing versatility in the preparation of monodisperse emulsions.
- The spacing between the inlet capillary's micro-capillary tip and receiving orifice can be adjusted to control the droplet size of emulsions.
- The use of simple components and manual fabrication makes this device cost-effective compared to complex, high-precision alternatives.
- Traditional devices often face clogging or compatibility issues with solvents. This device addresses these issues, especially for organic or hydrocarbon solvents.
- Existing systems often require complex cleaning procedures or are prone to contamination. This device's design allows easy disassembly and simplifies cleaning and reusability.
- Many conventional devices are limited to fixed droplet sizes, while this invention allows for adjustable droplet sizes, enhancing customization and control.
- The device is simple to fabricate with low-cost materials and is durable for long-term use, unlike high-cost or precision-required devices.

**CONTACT US**
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**IITM TTO Website**:
https://ipm.icsr.in/ipm/

**Email**: headtto-icsr@icsrpis.iitm.ac.in
tto-mktg@icsrpis.iitm.ac.in
**Phone**: +91-44-2257 9756/ 8369