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Technology Transfer Office
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Industrial Consultancy & Sponsored Research (IC&SR)

Method for Fabricating Microfluidic Devices on Porous Substrates

IITM Technology Available for Licensing

Problem Statement

- Current **microfluidic device fabrication methods** are complex, require specialized equipment, and use costly chemicals, making them **unsuitable for cost-effective mass production.**
- These methods, including **wax printing**, **struggle to achieve precise hydrophobic-hydrophilic boundaries**, **leading to poor device resolution**.
- Specialized materials, harsh chemicals, and printer modifications in existing techniques **hinder their widespread adoption,** particularly in **resource-constrained settings.**
- Hence, an **accessible, low-cost, user-friendly fabrication method** is needed that allows rapid prototyping & mass production, catering to diverse settings, including resource-constrained regions & home healthcare applications.
- The present disclosed patent is needed that addresses above mentioned issues by providing a **Method for Fabricating Microfluidic Devices on Porous Substrates.**

Technology Category/ Market

Categories: Chemistry & Chemical Analysis | Biotechnology & Genetic Engineering

Industry: Biotechnology, Healthcare and Medical Devices, Analytical Chemistry, R&D

Applications: DNA analysis, protein assays, cell sorting, drug discovery, fluid manipulation, chemical analysis, point-of-care diagnostics, disease detection, monitoring health parameters

Market: The Microfluidics Market size is expected to grow from **$ 28.38 B** in **2023 to $ 56.57 B** by **2028,** at **14.79% CAGR** during the forecast period **(2023-2028).**

Intellectual Property

IITM IDF Ref. 1772

Application No. 201841039420

PCT No. PCT/IN2019/050767

TRL (Technology Readiness Level)

TRL- 3, Proof of Concept & validated in Lab

Research Lab

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Technology

- The present patent disclosure relates to **Fabricating Microfluidic Devices (flow control devices) on porous, hydrophilic substrates,** especially for lab-on-a-chip and lateral flow devices.
- To see the device's operation, **light-colored toner encloses hydrophilic areas**. This process do not affect **fluid flow within microfluidic network**.
- The method involves **manual or automatic application of hydrophobic toner using laser printing**. Multiple microfluidic devices can be stacked to make a 3D structure.

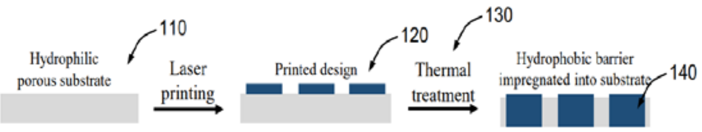

Figure 1 shows the steps for making microfluidic devices on porous substrates using laser printing technology.

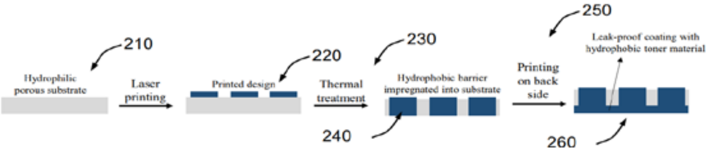

Figure 2 depicts the steps for creating sealed and leak-proof microfluidic devices on porous substrates using laser printer technology.

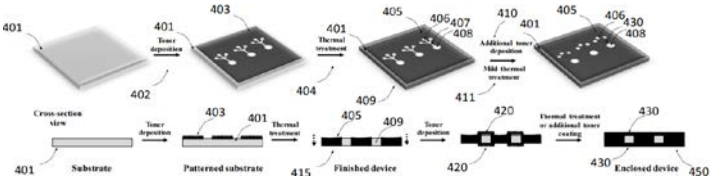

FIG. 3 shows step by step procedure for fabrication of enclosed/encapsulated microfluidic device.

Key Features / Value Proposition

❖ ***User Perspective:***

- This method **simplifies microfluidic device fabrication & allows for customized designs.**

❖ ***Technical Perspective:***

- It offers **precise patterning using laser printing and works on various substrates**.

❖ ***Industrial Perspective:***

- It is **cost-effective**, **ensures quality, and enables rapid prototyping for diverse applications**, giving a competitive edge.

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Method for Fabricating Microfluidic Devices on Porous Substrates

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The Method for Fabricating Microfluidic Devices on Porous Substrates comprises following steps:

1. • Applying hydrophobic toner material to a porous substrate in a specific pattern on one surface. The porous substrate is suitable for creating microfluidic devices.

2. • Subjecting the substrate with the hydrophobic toner to a thermal treatment process, ensuring the complete penetration of at least one hydrophobic polymer from the toner material throughout the thickness of the porous substrate. This forms a fluid-resistant barrier on the substrate.

3. • Adding an additional toner layer selectively to the top, bottom, or both surfaces of the patterned substrate, effectively sealing it with hydrophobic toner material to create a leak-proof microfluidic device.

4. • Subjecting the substrate with the additional toner layer to a gentle thermal treatment process to ensure the device is leak-proof by allowing lateral permeation of the hydrophobic polymers.
   • This method also defines at least one hydrophilic region connected to a fluid impervious hydrophobic barrier on the porous substrate.

Images

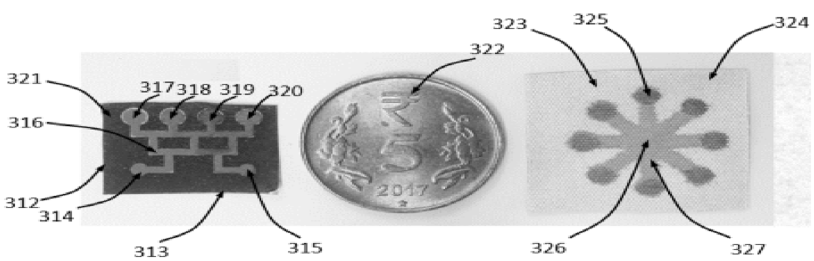

FIG. 4 displays 2 microfluidic devices:

- a concentration gradient generator made from tissue paper and
- a multiplexed microfluidic device with layered dyes on polyester-cellulose task wipes.

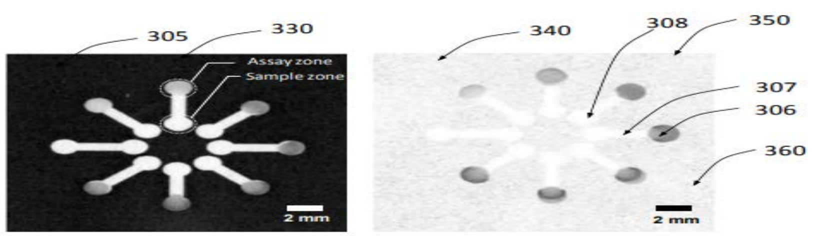

FIG. 5 is an illustration of a microfluidic paper-based analytical device (μPAD) for detecting various analytes.

- It includes front & back surfaces with different zones for conducting tests and introducing samples.
- The assay zone is coated with reagents that change color when analytes are present.

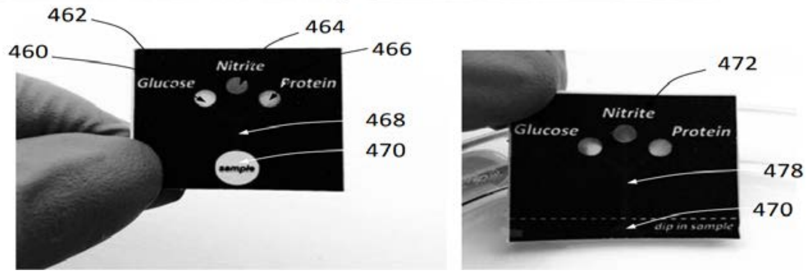

FIG. 6 shows an illustrative microfluidic paper-based analytical device (**μPAD**) for the detection of various analytes
For example but not limiting to: glucose, nitrite and protein.

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