IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

2D SUBSTRATE PROTEIN MICROPATTERNING PROCESS FOR CELL ALIGNMENT

IITM Technology Available for Licensing

PROBLEM STATEMENT

- Cells interact with the **Extracellular Matrix (ECM)** through **receptors like Integrin**, sensing mechanical and chemical stimuli.
- **Organs have unique structures** and alignments, making **2D and 3D patterned** microenvironments **crucial for cell growth** in tissue-engineered organ substitutes.
- **Tissue engineering techniques** create customized microenvironments for **cell alignment**, varying from organ to organ.
- **Techniques** include electromagnetic fields, electrophoretic force, nanofiber scaffolds, 3D gels, and microstructure substrates.
- There is **no techniques using chemical stimulus** to achieve cell affinity and align cells on a substrate.
- The **need** for an **improved 2D substrate protein micropatterning process** exists to **align cells in a specific pattern** by providing chemical stimulus, achieving cell affinity to the specific stimulus.

TECHNOLOGY CATEGORY/ MARKET

Technology: Process for fabricating a SU 3D structure on a silicon substrate
Category: Precise single cell analysis
Industry: Biomedical industry
Application: Tissue engineering ,nanotechnology
Market: The global market size was estimated to be worth **$3.5 billion in 2023** and is **poised to reach $7.1 billion by 2028,** growing at a **CAGR of 15.3% from 2023 to 2028**

INTELLECTUAL PROPERTY

IITM IDF Ref. 1966
Patent No: IN 486480

TRL (Technology Readiness Level)

TRL- 4, Experimentally validated in Lab;

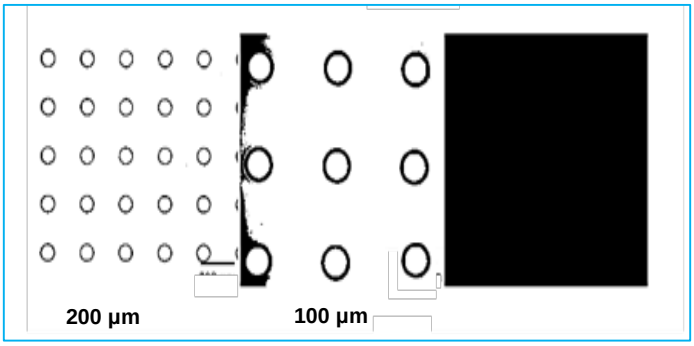
Research Lab

Prof. Tuhin Subhra Santra,
Dept. of Engineering Design

TECHNOLOGY

2D Substrate Protein Micropatterning Process

1. **Forming mold using SU8 3D structure on silicon substrate.**
2. **Casting polydimethylsiloxane (PDMS) stamps using SU8 3D structure.**
3. **Cleaning silicon substrate with Piranha solution at 80°C for 10 minutes and washing in deionized water.**
4. **Dried with nitrogen blow, kept at 120 °C for 5 minutes for dehydration in order to form the SU8 3D structure**
5. **Casting PDMS pillar array using mold.**
6. **Aligning cells in a specific pattern using 2D substrate.**
7. **Achieving cell affinity to specific chemical stimulus**



The figure above illustrates a graphical representation of a final 3D SU8 mold on silicon substrate showing an array of through-holes in SU8 observed under optical microscope

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

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

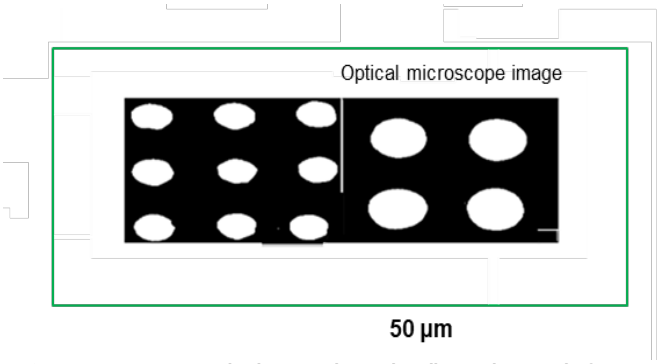
Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719

IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

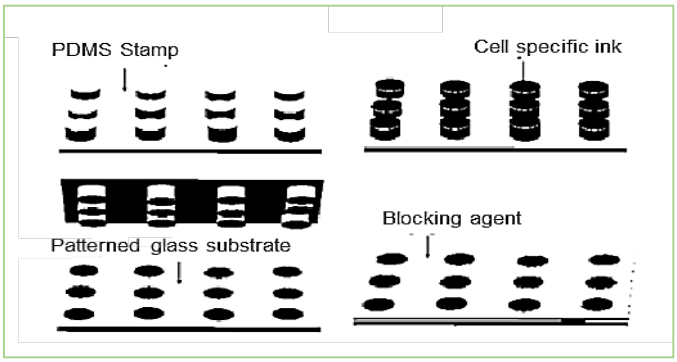
Industrial Consultancy & Sponsored Research (IC&SR)

Fluorescence image of the pattern printed by the PDMS stamp on a glass substrate



- **SU8 3005** (Micro chemical) selected for 3D mold creation.
- Spin-coated on silicon sample at **1000 rpm for 60 seconds.**
- Soft-baked at **95 ºC for 3 minutes**.
- Patterned with a mask using **UV lithography machine.**
- Hard-baked at **65 ºC for 1 minute**, followed by 95 ºC for 2 minutes.
- Cooled to room temperature and developed in **SU8 developer for 3 minutes**.
- Substrate washed with Isopropanol and **dried with nitrogen blow.**
- Optical microscope observed final sample with through-holes.

DMS stamping procedure for cell patterning



Mixing PDMS with a curing agent and

Treating SU8 substrate with **trichlorosilane.**

Transferring the mixture to the substrate.

Testing the final stamp with fluorescein ink.

Activating the stamp with protein solution.

Printing the protein on a tissue culture plate.

Seeding Siha cells on the patterned plate.

Staining cells with Calcein AM and observing under a fluorescence microscope.

Key Features / Value Proposition

❑ **Structure**
- A mold is formed using a SU8 3D structure on a **silicon substrate** for casting polydimethylsiloxane **(PDMS) stamps**.
- The **SU8 3005** (Micro chemical) is selected for making the 3D mold.
- The **SU8 3D** structure is **spin-coated, soft-baked, patterned, hard-baked**, and developed in a SU8 developer.

❑ **Cell Alignment**
- Innovative Cell Alignment Process in **Extra Cellular Matrix (ECM)** Structure
- Improved 2D substrate protein micropatterning process for cell alignment.

❑ **Cell affinity**
- Provides chemical stimulus to cells, enabling them to align in a specific pattern and achieve cell affinity.

❑ **Toxicity**
- The process is **nontoxic,** easy to implement, and **can pattern heterogeneous cell lines.**

❑ **Performance**
- Efficient analysis of genetic disorder for the patient at a single cell level
- Precise **genome and transcriptome analysis** at the single cell level, provide **functional consequence of mutation** and copy number variation of cells

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: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719