Micropatterning polymer brushes on confined surfaces using two-photon-initiated RAFT polymerisation

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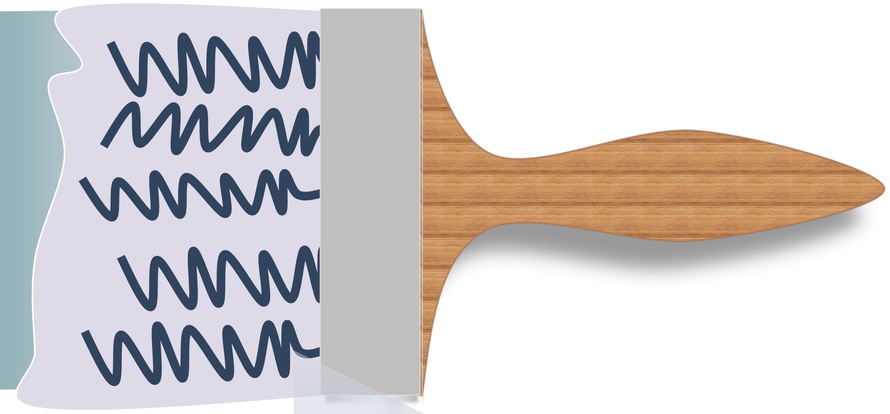
Introduction

Polymer brushes can provide tunable surface functionality –vital for sensors, implants and tissue scaffolds.
Challenge: Patterning polymer brushes in complex geometries limited by current methods.
Solution: 2-Photon absorption to initiate RAFT polymerization directly on surfaces



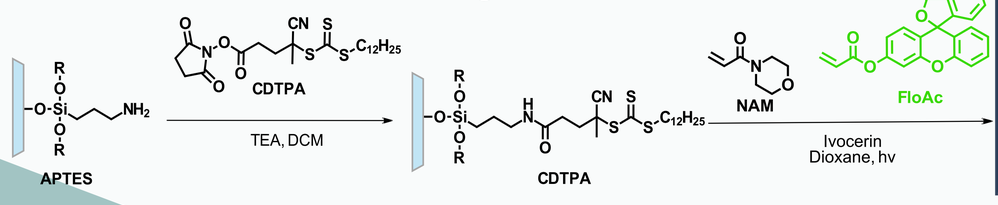
Methods

RAFT agent: **CDTPA**

Monomer: Biobiocompatible & hydrophilic **NAM**

Substrate: Si wafers modified with CDTPA

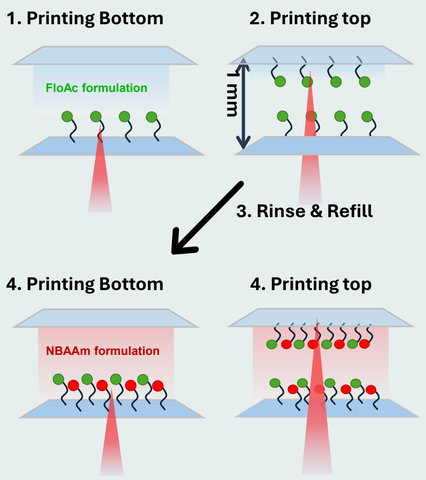
Conditions: 420:1 NAM:CDTPA, blue light

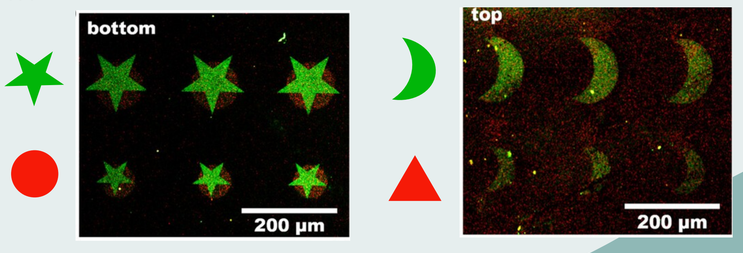


Multichemistry & Confined Printing

Multicolour: FloAc & Nile Blue acrylamide (NBAAm)

Formulations:
NAM:CDTPA:FloAc:M2CMK=420:1:1:1
NAM:CDTPA:NBAAm:M2CMK=420:1:1:1



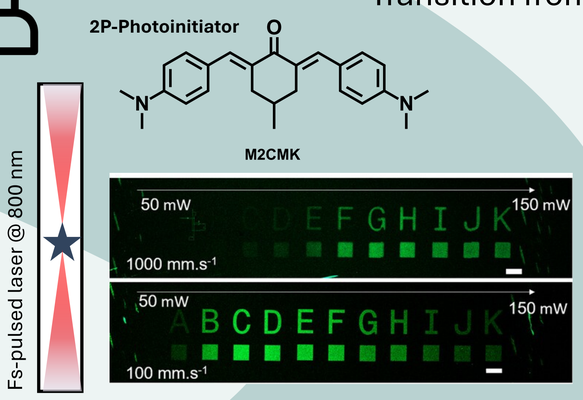


- ✓ Dual-side patterning
- ✓ No cross-talk between layers
- ✓ Fine resolution up to 5 µm

2Photon RAFT (2PRAFT)

Transition from RAFT to 2PRAFT:

- Change of photoinitiator to M2CMK
- Formulation: NAM:CDTPA:FloAc:M2CMK=420:1:1:1
- Substrate: Microscopy Coverslips



Optimal Conditions:

- Fluorescence @ 100 mm/s
- Best performance @ 80 mW

Conclusions

- ✓ 2PRAFT method was developed for the first time, and used for polymer brush patterning.
- ✓ Well-defined brushes with 10 nm height and structures with edges down to 5 µm were produced.
- ✓ Created multicolour images & print different patterns on adjacent surfaces.
- ✓ Applications: Controlled cell adhesion, microfluidic devices.

REFERENCES & ACKNOWLEDGEMENTS

[1] Helfert, S.; Zandrini, T.; Rohatschek, A.; Rufin, M.; Machata, P.; Zahoranová, A.; Andriotis, O.G.; Thurner, P.J.; Ovsianikov, A.; Liska, R.; Baudis, S.; Micropatterning of Confined Surfaces with Polymer Brushes by Two-Photon-Initiated Reversible Addition–Fragmentation Chain-Transfer Polymerization. Small Science, 5(1), p.2400263, DOI: 10.1002/smsc.202400263.

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