

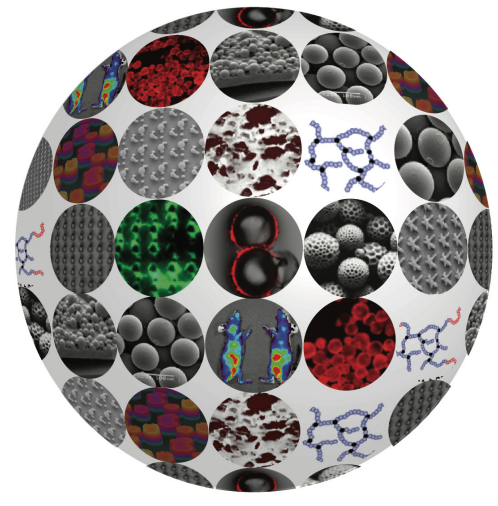
Combinatorial Material-Topography Screening: The ChemoTopo Chip

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Aim

Next Generation Biomaterials Discovery



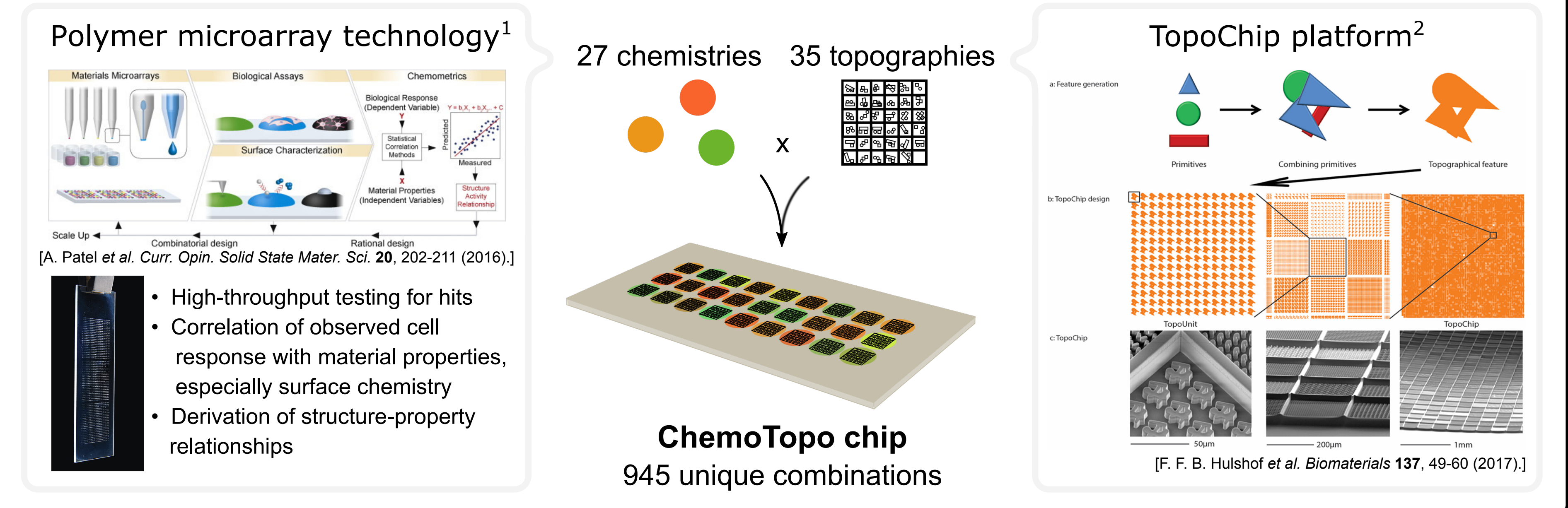
- Adding dimensionality to traditionally flat biomaterial screening approaches
- Discovery of bespoke polymers for applications in medicinal devices and regenerative medicine

Rationale

- Limits of traditional cell culture on polystyrene
 - Biochemically-induced, non-mature cell phenotypes
 - Planar, non-native cell environment
- Deficiency in number of clinically-relevant biomaterials
- Lack of understanding: biomaterial design parameters

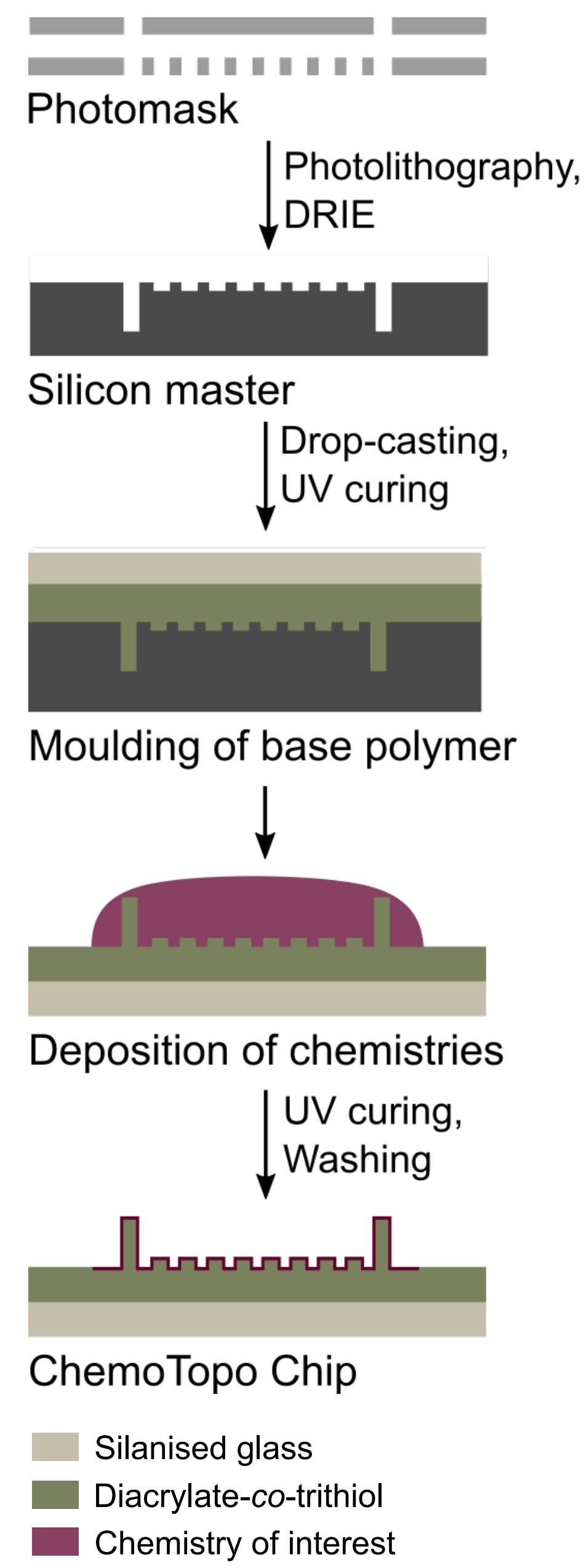
Concept

Exploit biomaterial chemistry and topography to achieve desired cell response

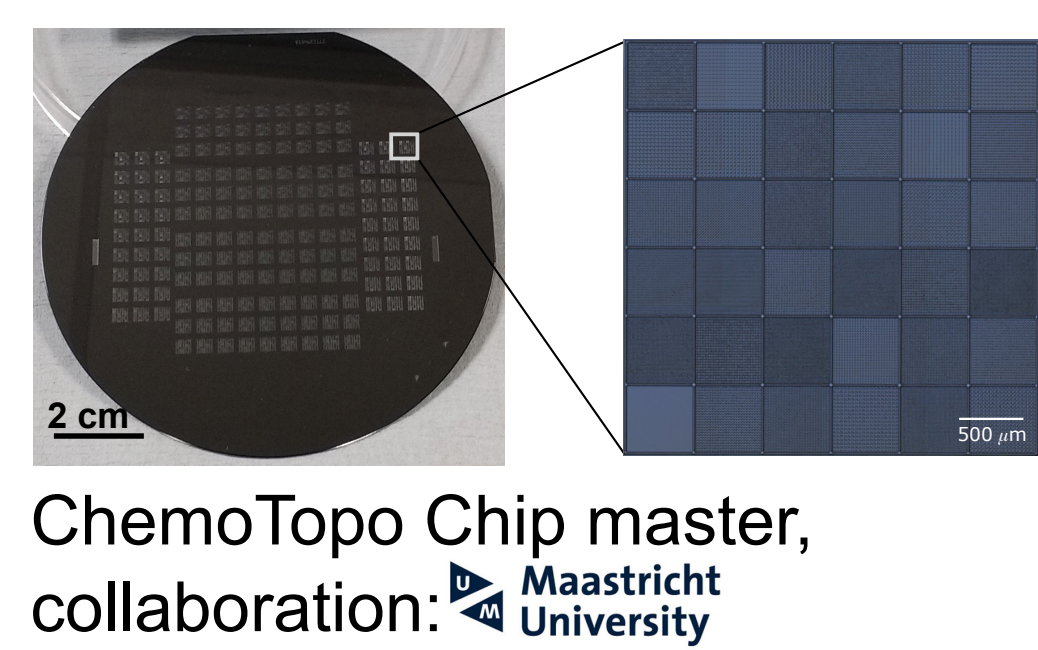


Sample fabrication: Thiol/ene chemistry, Surface-initiated polymerisation

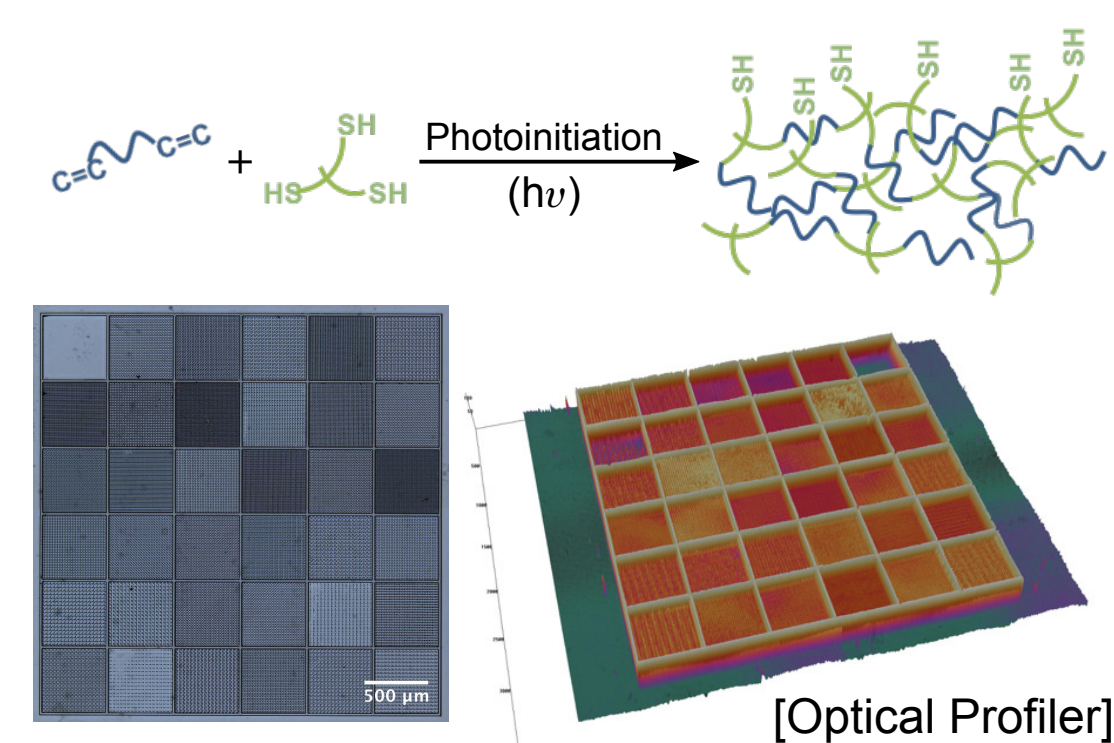
Fabrication route:



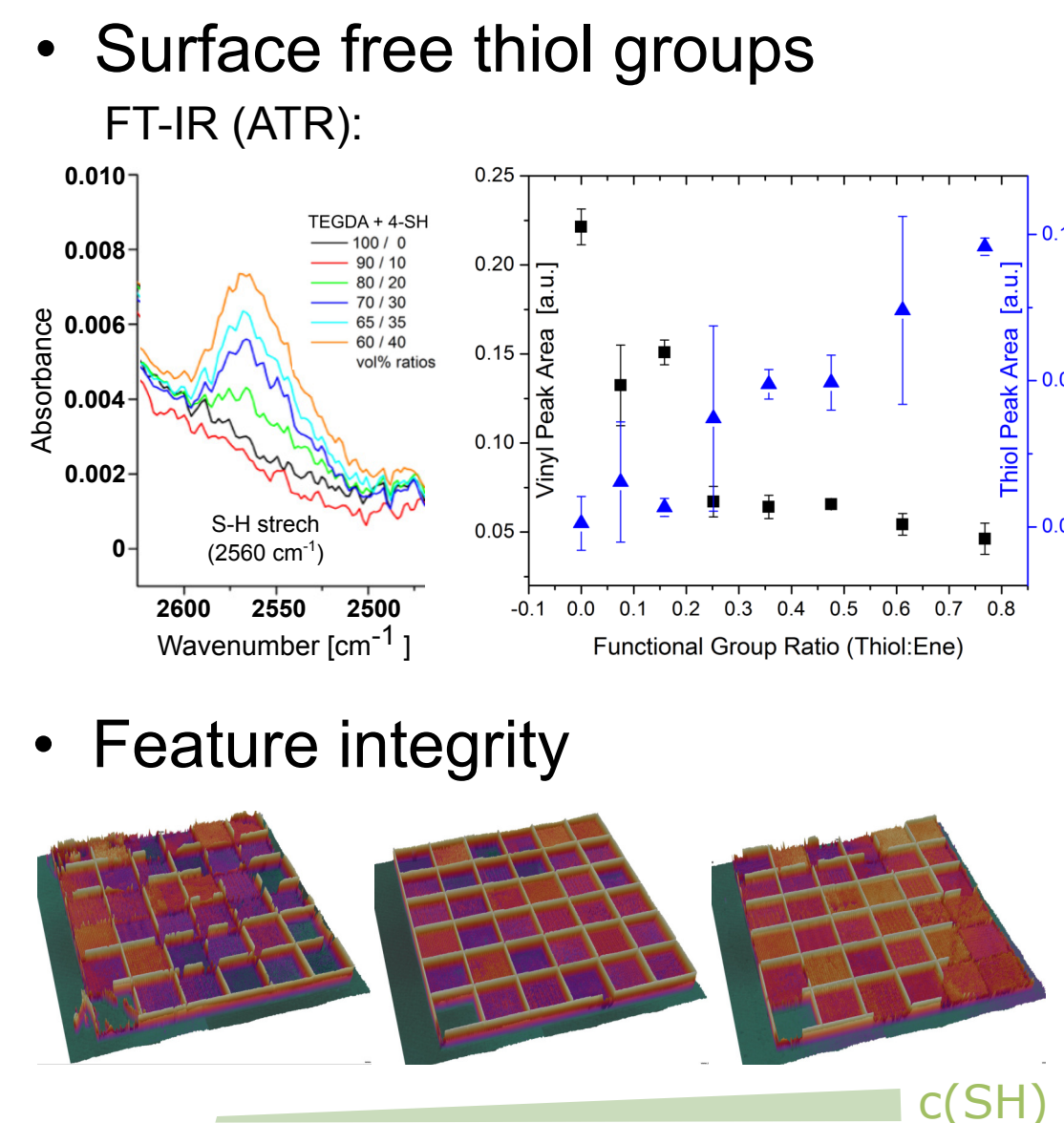
Silicon Master:



Moulding of base polymer:



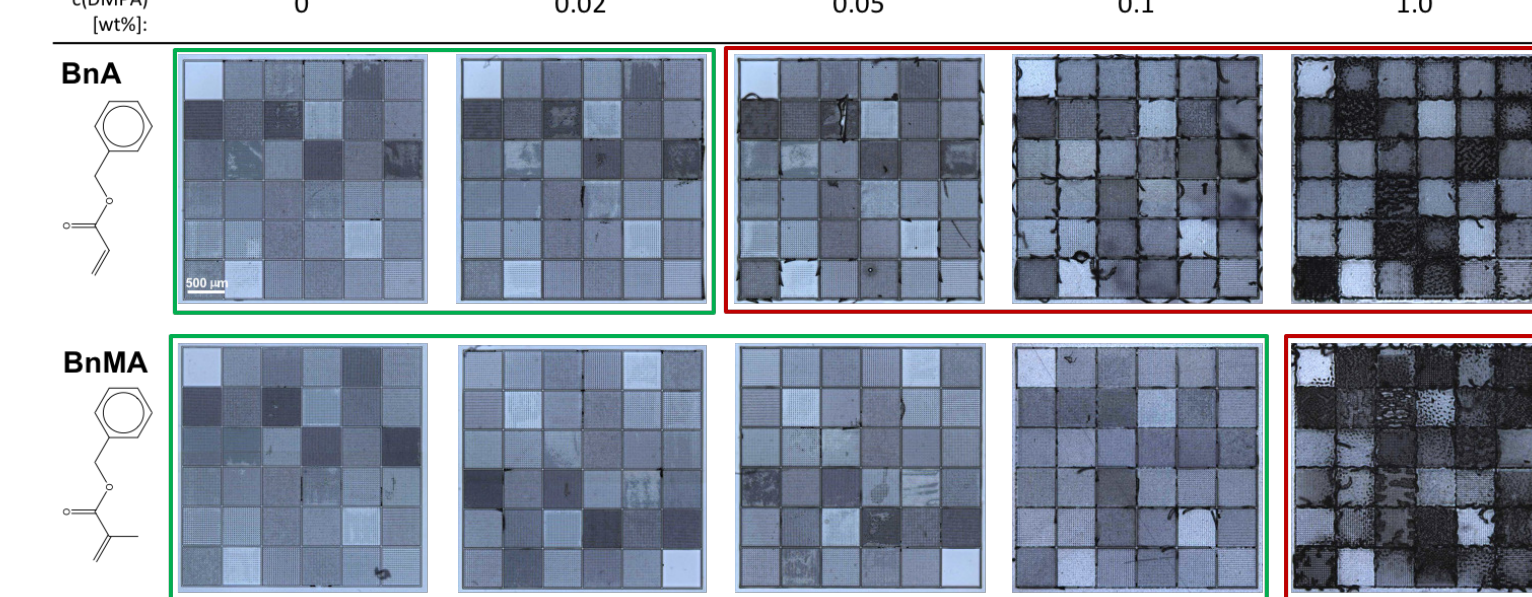
Film composition affects:



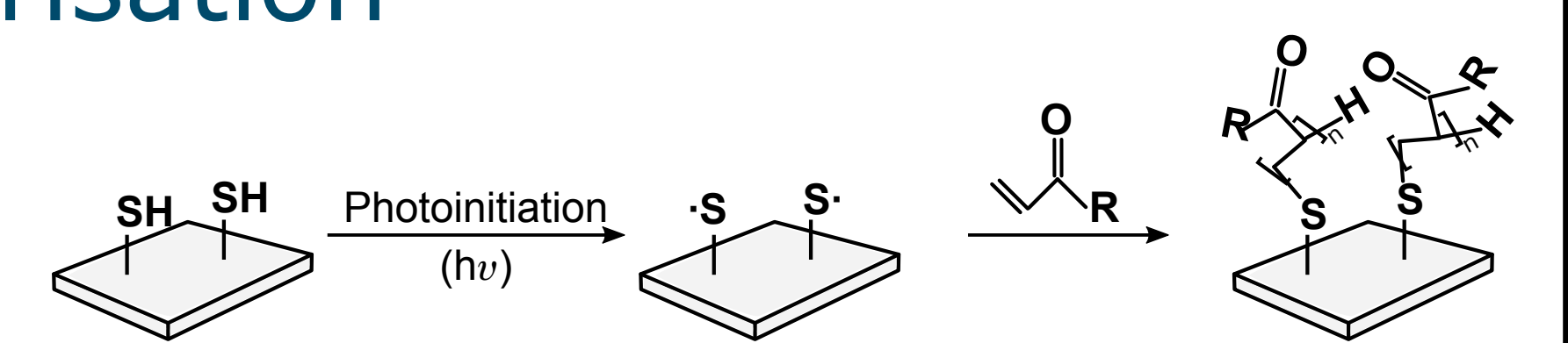
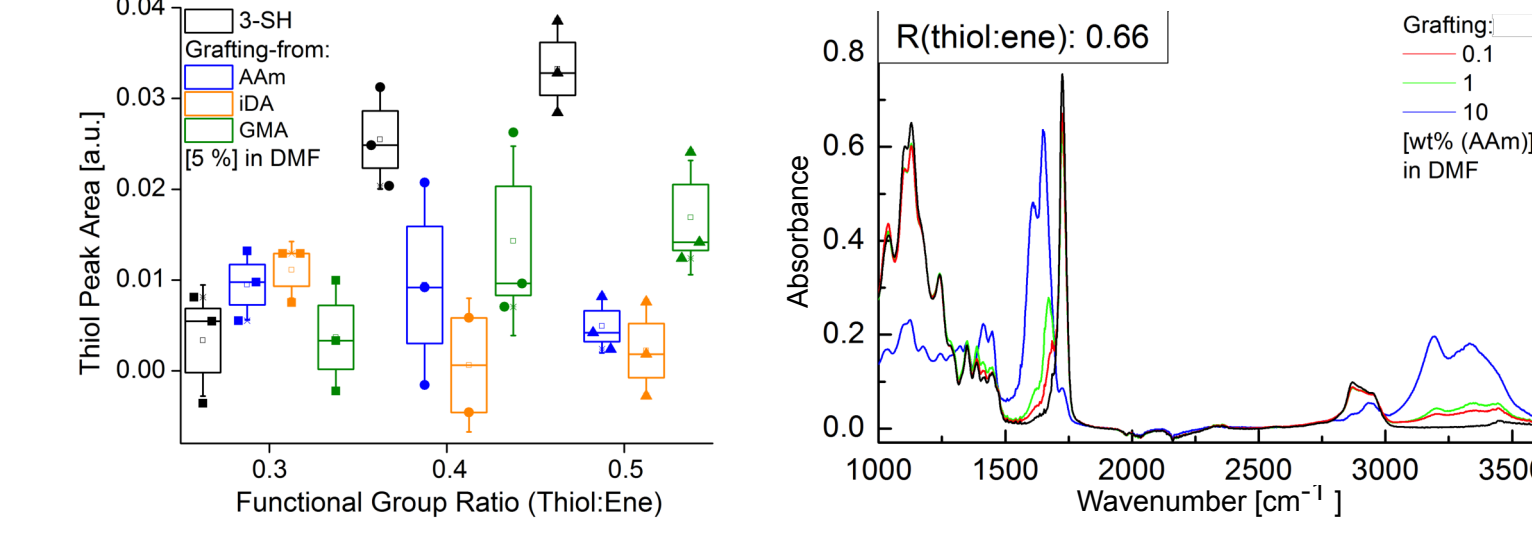
Deposition of chemistries:

Surface-initiated polymerization of chemistries to pendant thiol groups of pre-formed chip³

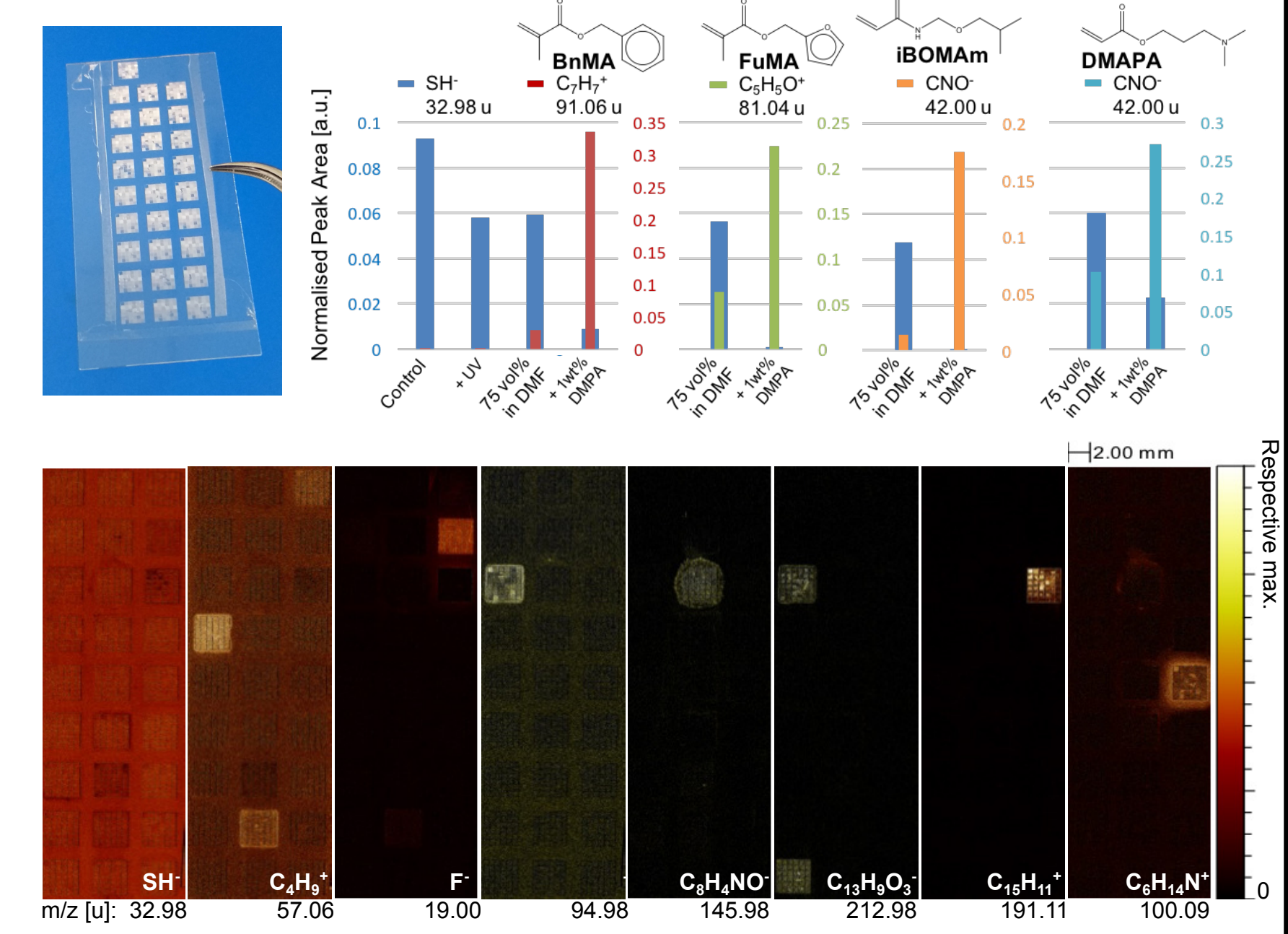
- Monomer functionality determines $c(\text{photoinitiator})$



- Verification of polymer grafting: FT-IR (ATR)

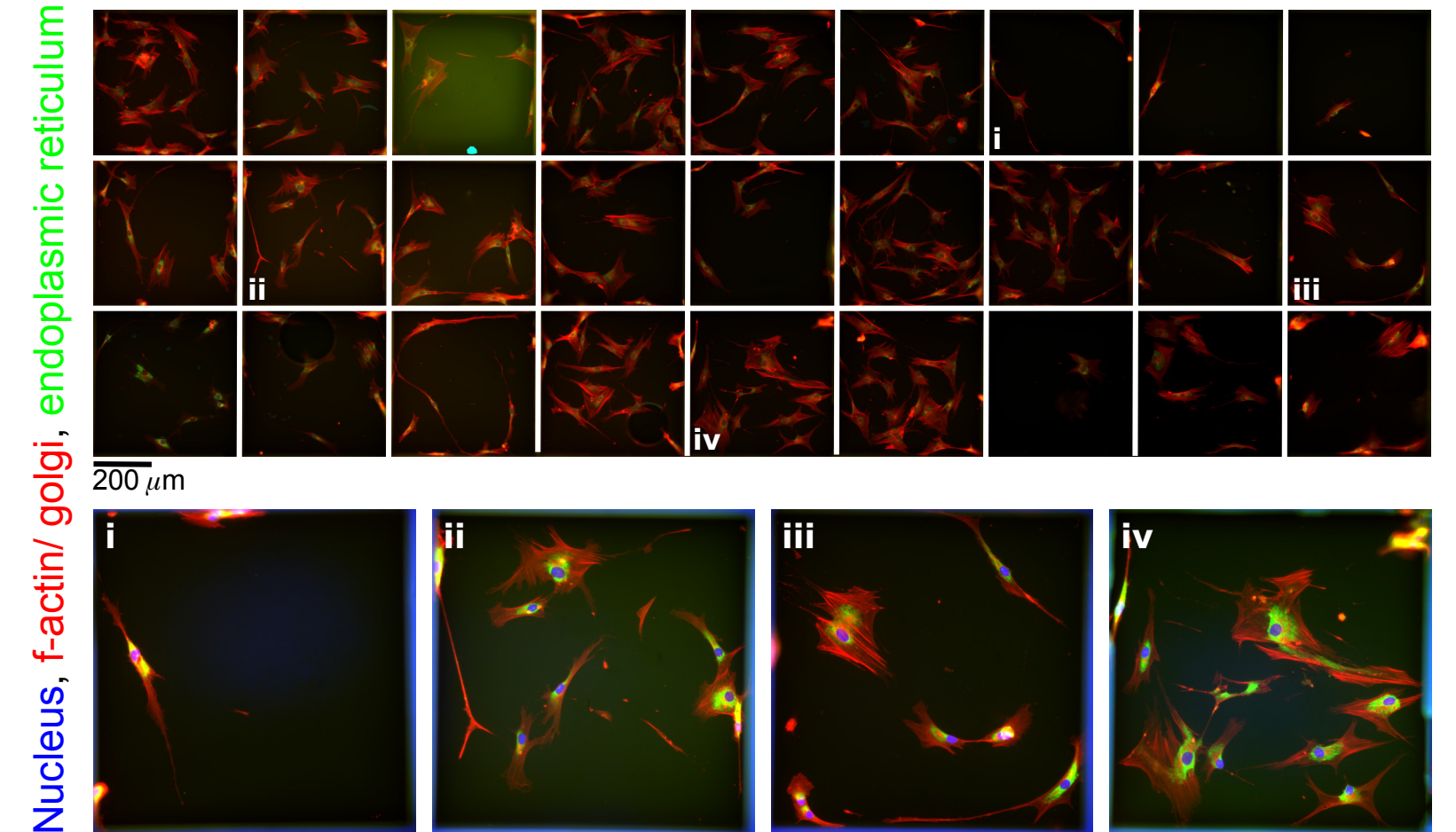


- Verification of polymer grafting: ToF-SIMS



Cell experiments:

Human mesenchymal stem cell morphology after 3d



Conclusions

- Successful fabrication of ChemoTopo Chip by surface-initiated polymerisation of chemistries to microtopographies
 - ✓ Integrity of microfeatures
 - ✓ Verification of surface modification for (meth)acrylates/ (meth)acrylamides
- First cell assay to confirm suitability of samples (compatibility with cell culture, immunocytochemistry, microscopy)
 - ✓ Modulation of primary hMSC morphology and potentially proliferation by both chemistry and topography

Outlook

- Upscale prototype fabrication to full-scale sample production, verify protocol robustness
- Full sample characterisation (FT-IR, ToF-SIMS, WCA, XPS, AFM)
- High-throughput screening to identify hit polymer + microtopography combinations for improved stem cell maturation or reduced biofilm formation
- Correlation of surface properties with cell response: computational modelling to derive structure-property relationships

References

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Acknowledgements

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