

EM μ : The next generation of separation science

Jeremy Galineau HPLC 2009

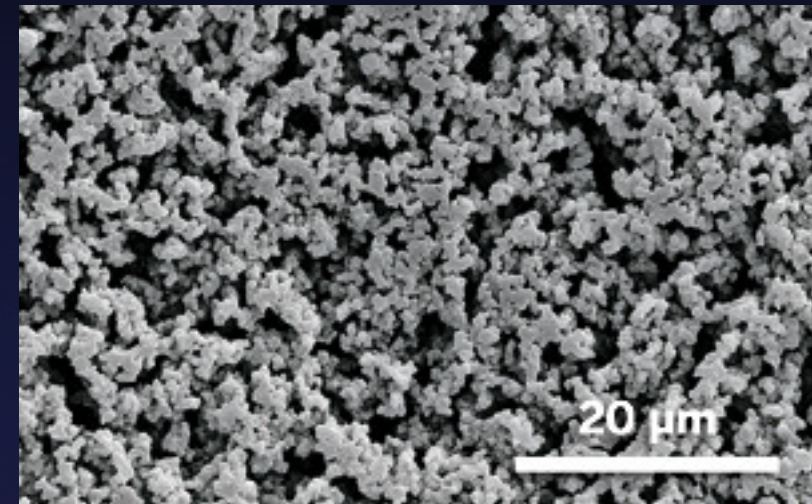
29/06/2009

Outline

- Introduction to monolithic columns
- Monolithic μ chips
- EM μ :
 - micro-structured monolith
 - electro-polymerization
- Preliminary results

Advantages of monolithic columns

- Laminar flow
- Less back pressure:
 - higher flow rate
 - faster separations
- Decrease A-term and C-term of the Van Deemter equation



Porous polymer monolith used in separation column
From Chemical & engineering news, vol 87, 20, p.
11-18

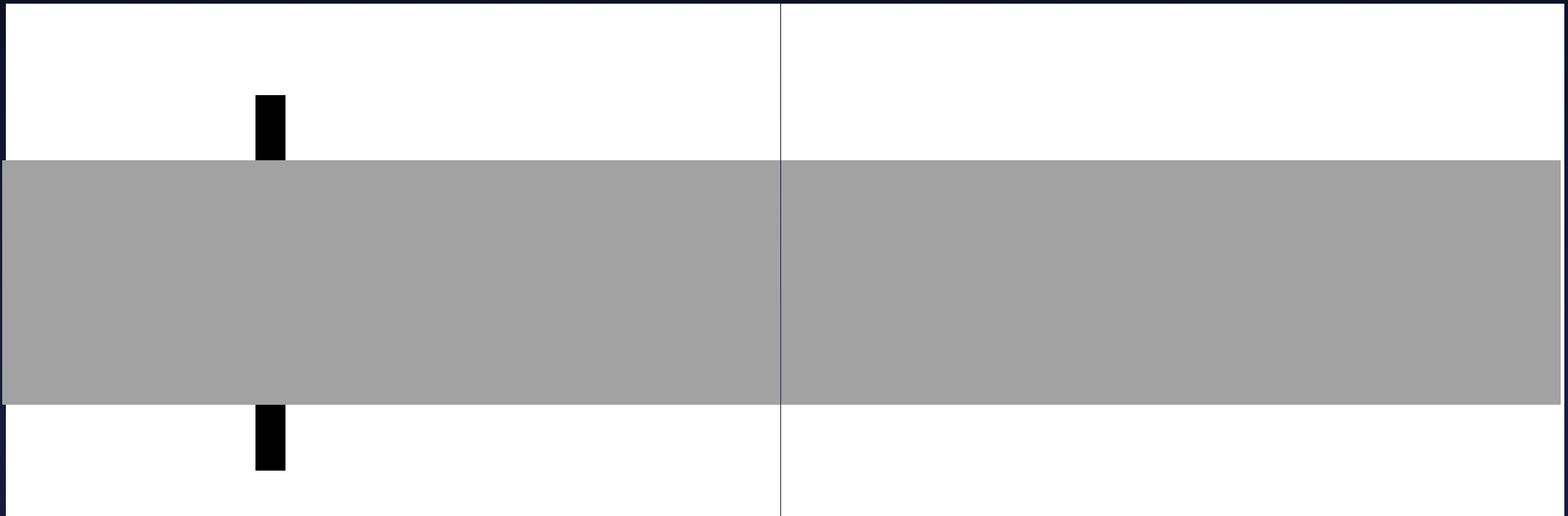
Limitations of monolithic columns

Lack of reproducibility:

- individual preparation
- chemical bonding (ex: C18 on silica monolith)

PREVENTING WIDESPREAD ACCEPTANCE
OF MONOLITHIC COLUMNS

Monolithic μ chips



Reproducibility issues



**How can reproducibility
issues be overcome ?**



**Electroactive monolith
 μ chips
(EM μ)**

EM μ

(electroactive monolithic microchip)

EM μ overcomes reproducibility issues

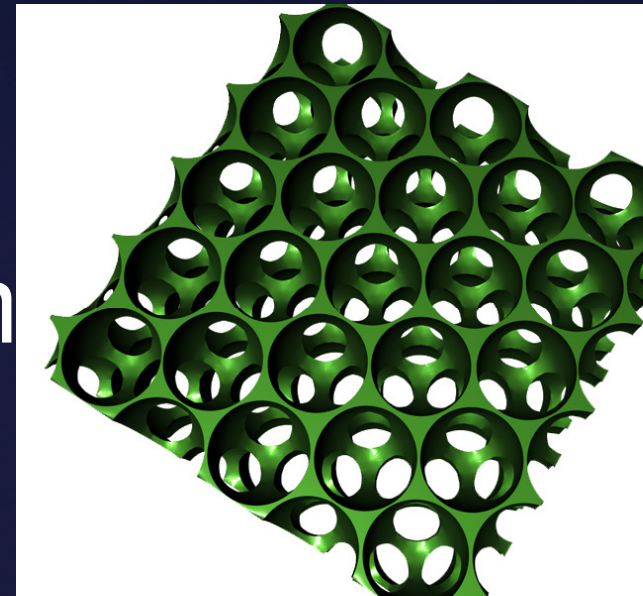
by:

Micro-structuring the monolithic stationary phase

Electro-polymerising the monolith

Micro-structured monolith

- Periodic structure provides:
 - reproducibility
 - further decrease of A-term
 - large flow-through pores
 - small skeleton size

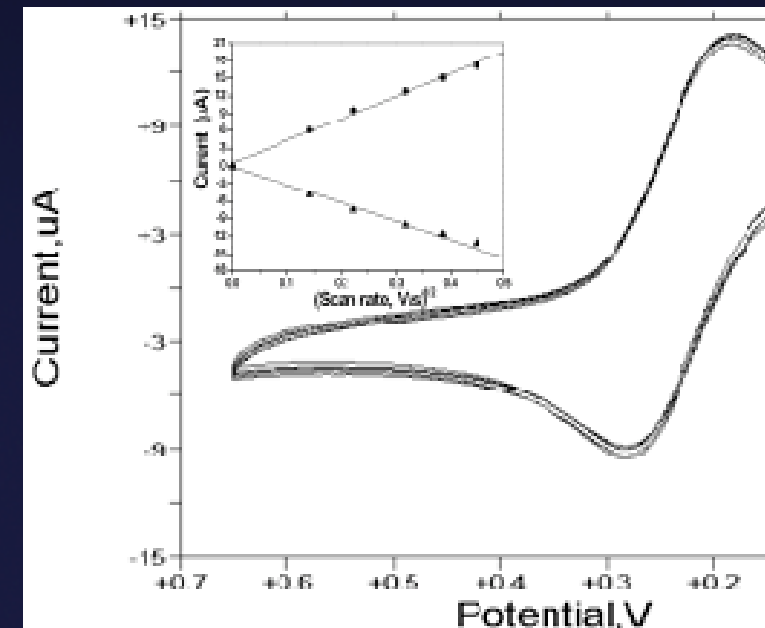


Electro-polymerisation

aration channel integrated into a 3-electrode electrochemical cell:

precise control over the polymerisation potential

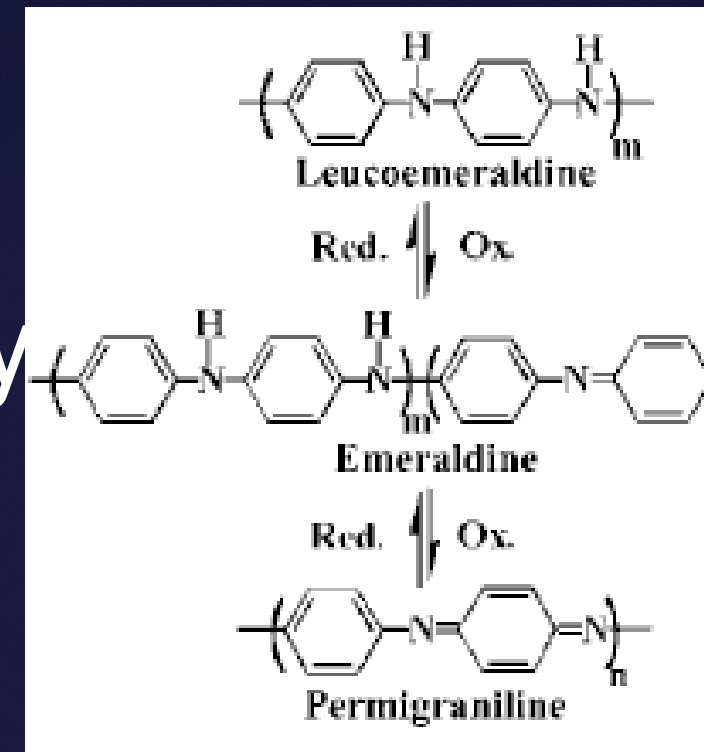
formation of a highly reproducible polymer



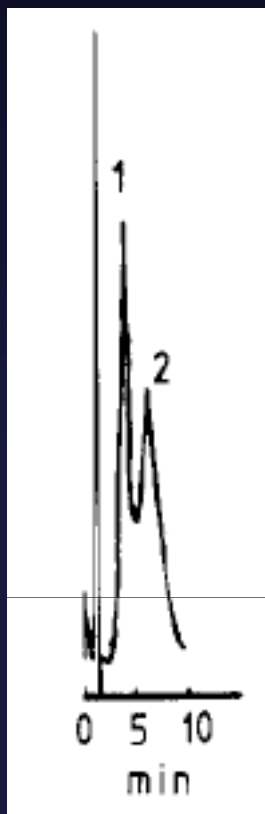
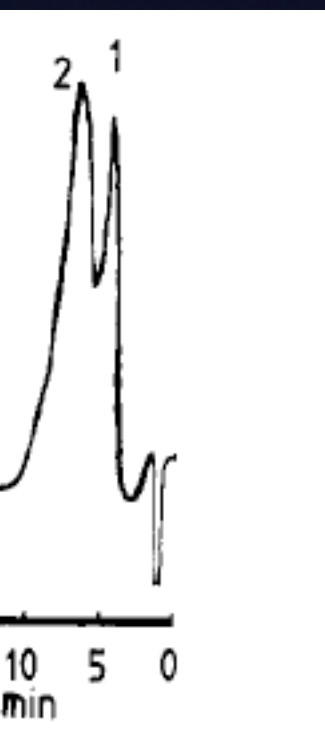
Advantages of an electroactive stationary phase

Allows precise tuning of stationary phase before AND during separations, controlling:

- Retention factors
- Hydrophobicity/ hydrophilicity
- Pore size
- Ionic capacity



separation on an electroactive polymer possible?



- Electroactive polymer polymerized onto «crushed» glassy carbon

Separation of p- and m-toluic acid (left)
on PP/SDS/RVC: mobile phase 55/45, H₂O/CH₃OH, 1 mL/min;

How is the EM μ monolith fabricated?

- 3 step process:

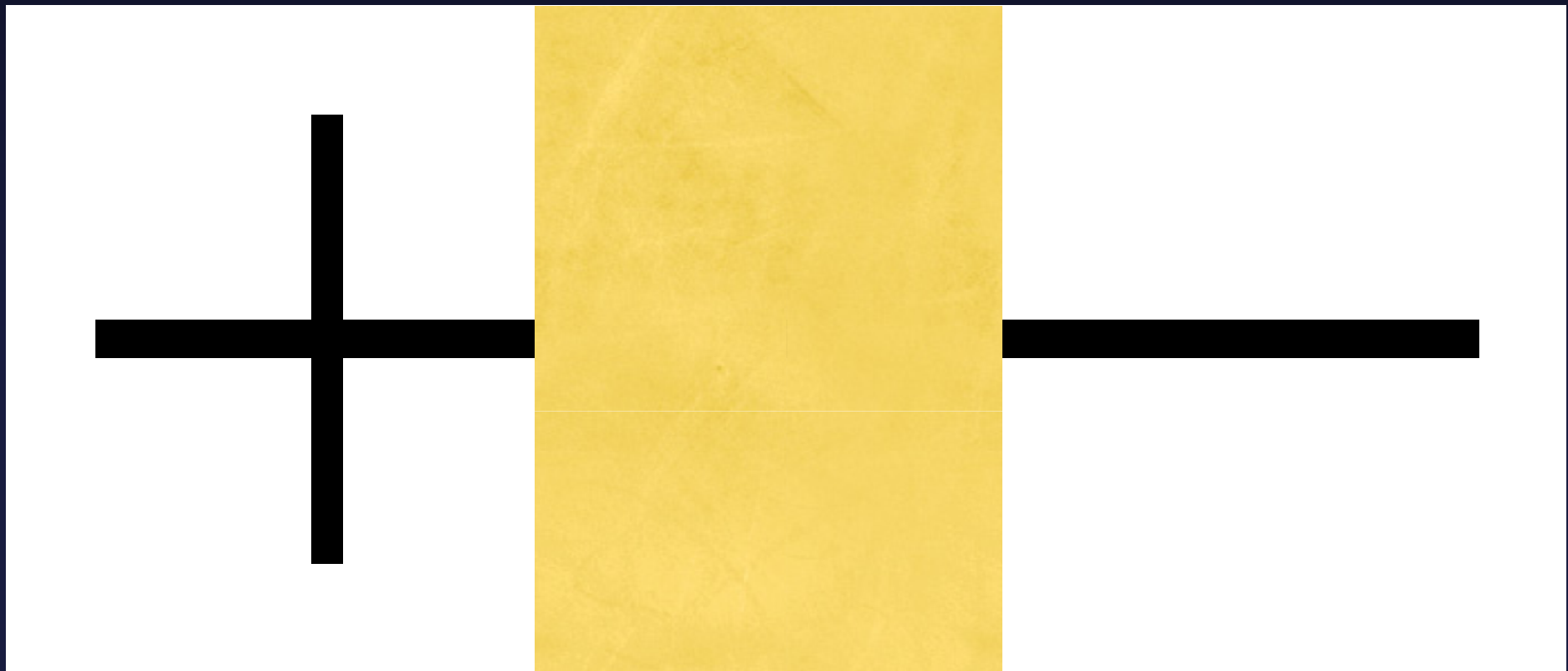
1. Formation of polystyrene bead template:

- colloidal crystallization using capillary forces

2. Electro-polymerization of polymer through the template

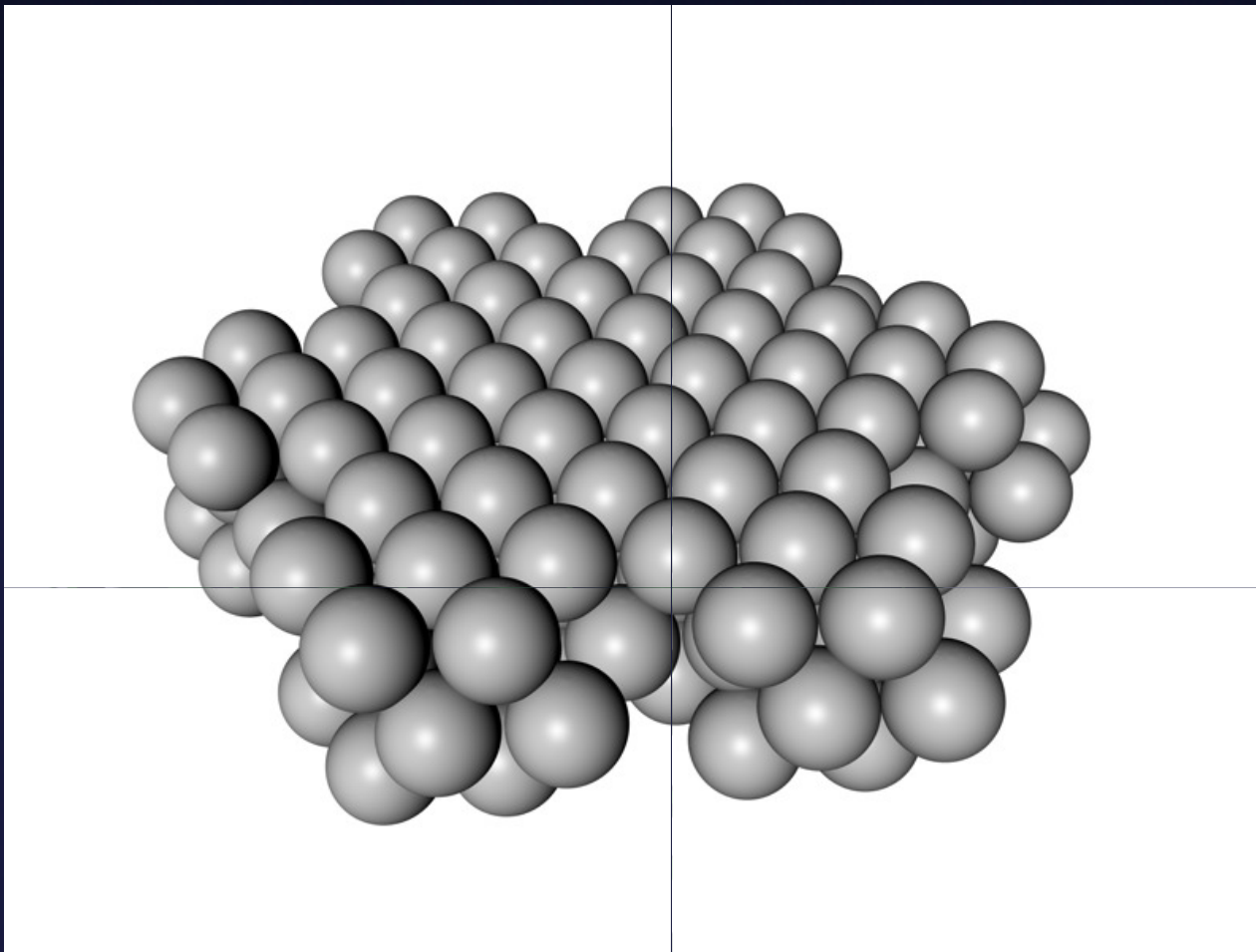
EM μ

(electroactive monolithic microchip)

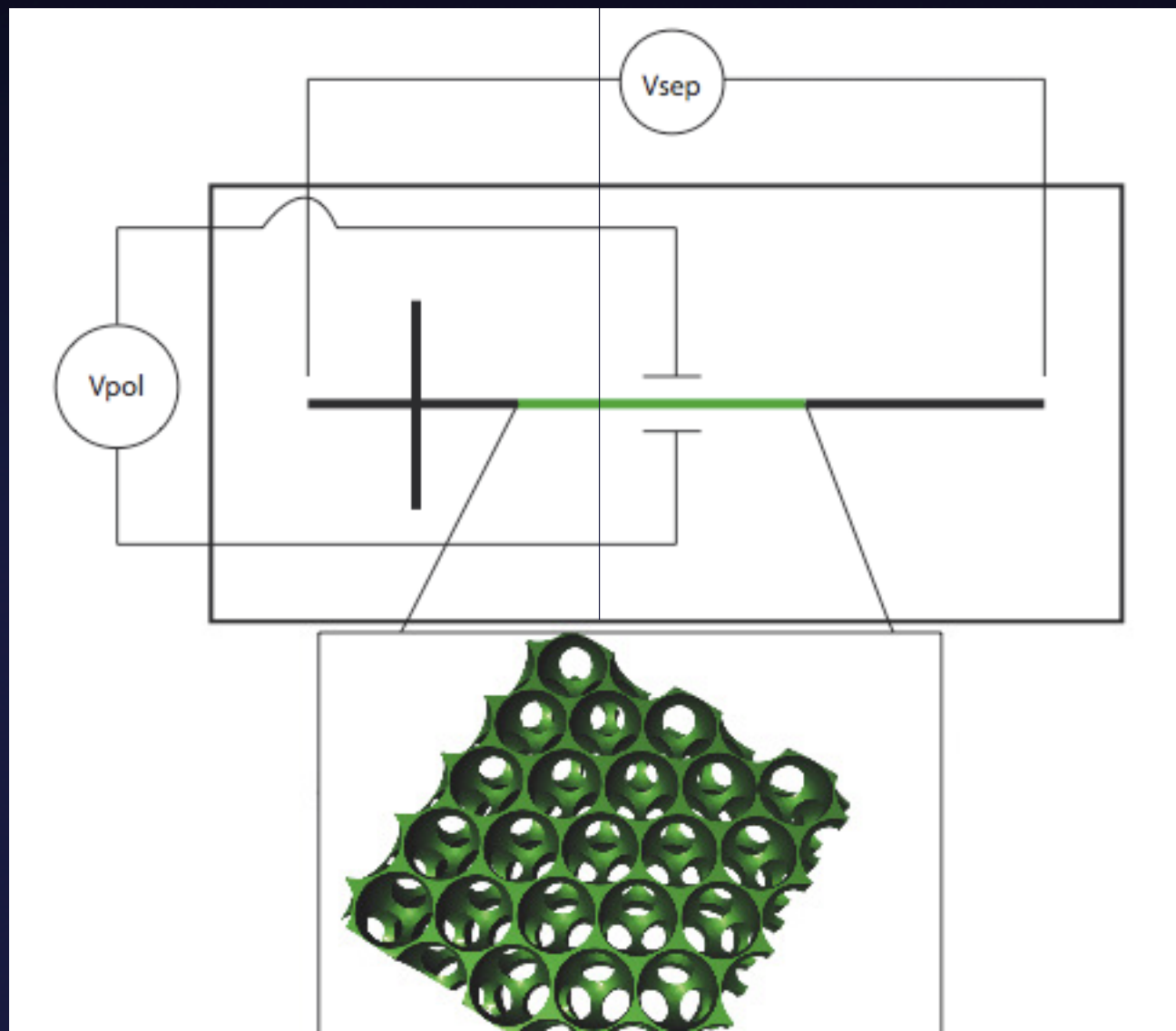


EM μ

(electroactive monolithic microchip)

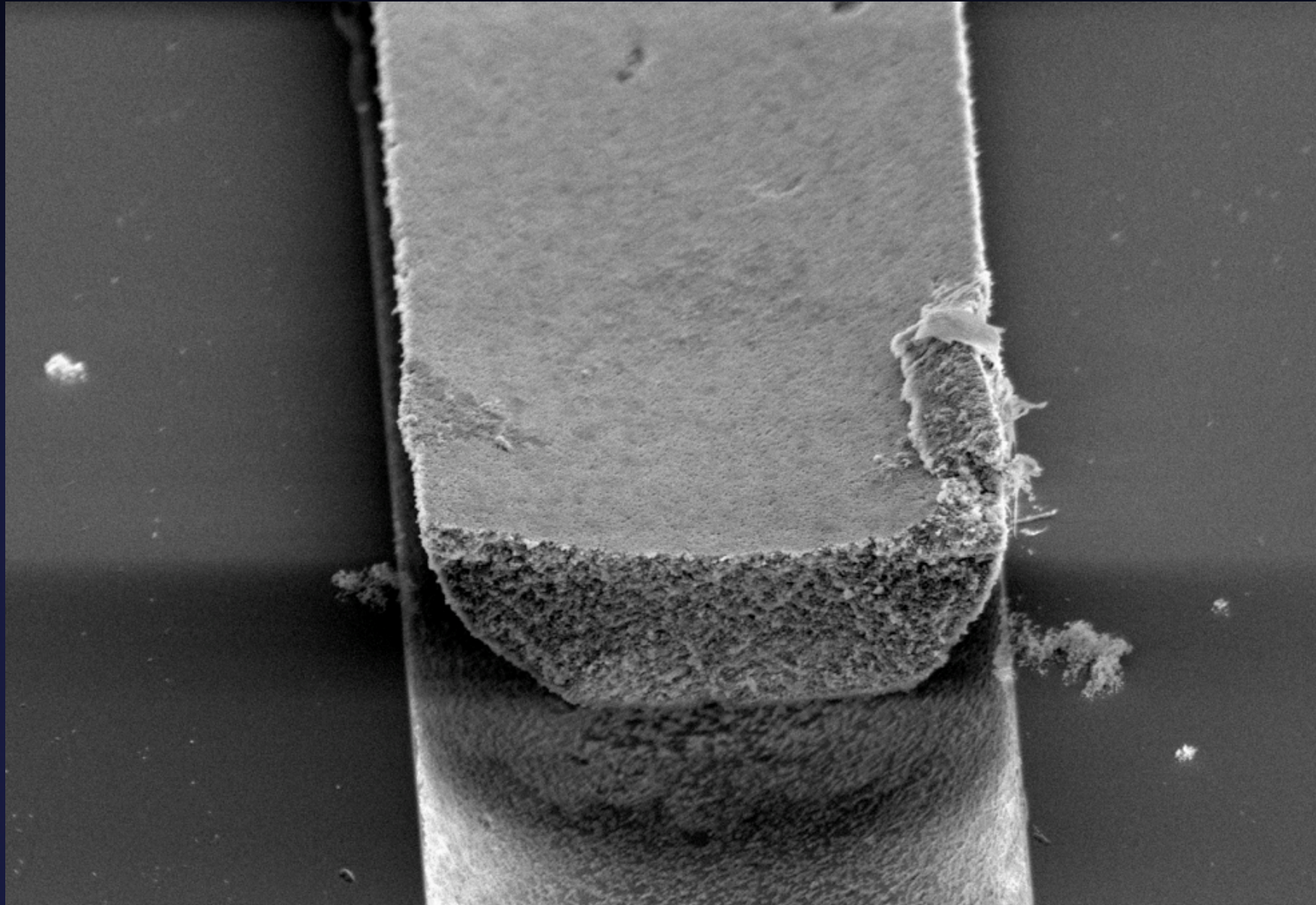
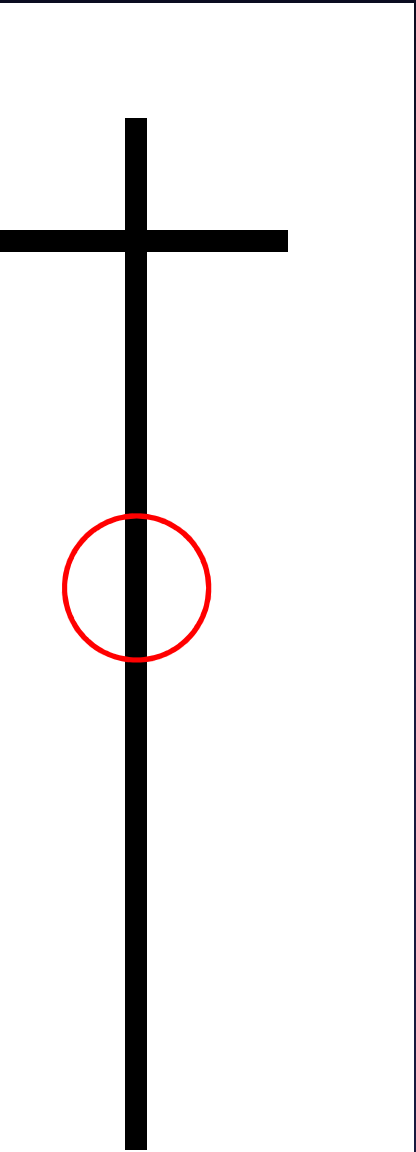


M μ (electroactive monolithic microc)



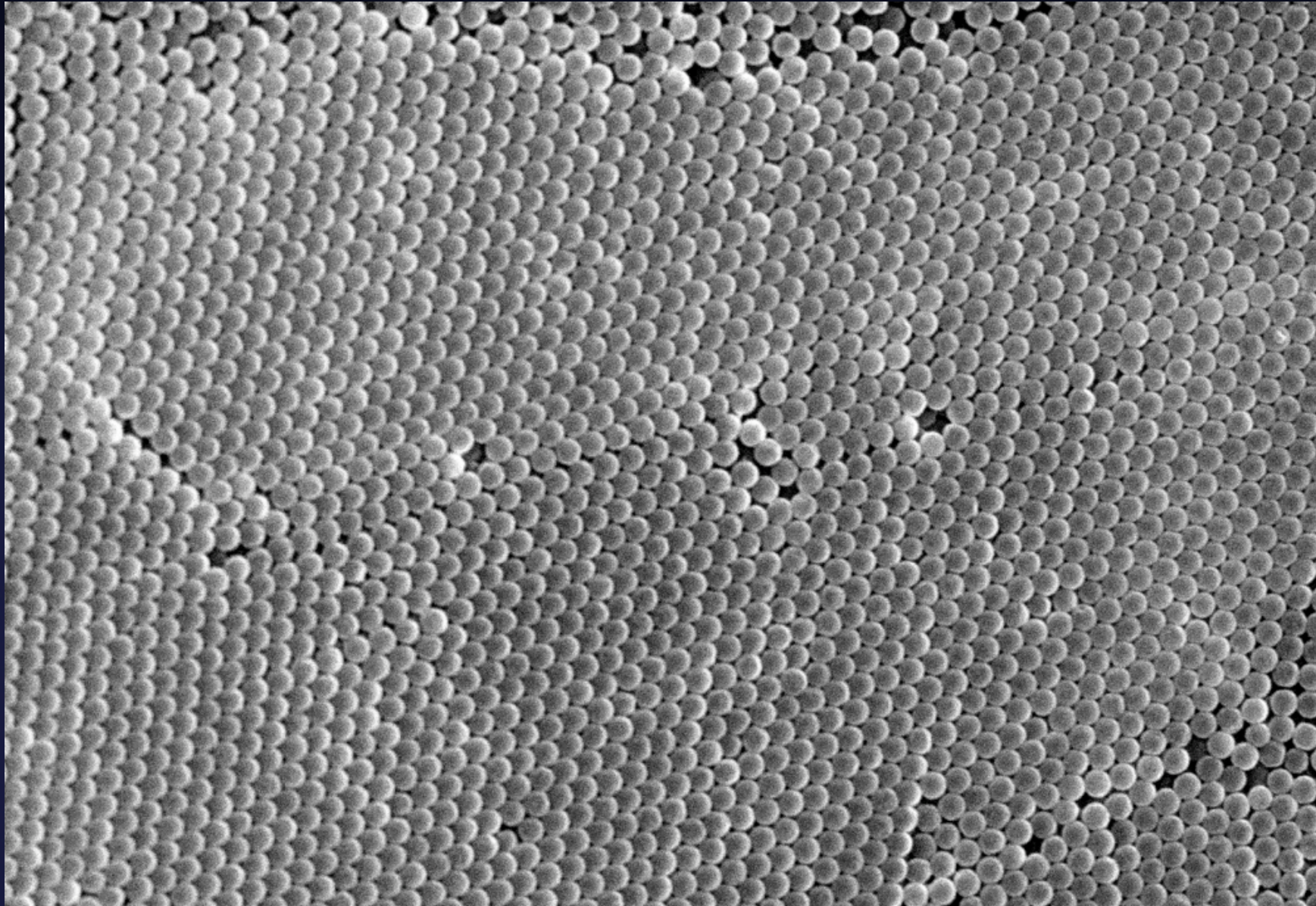
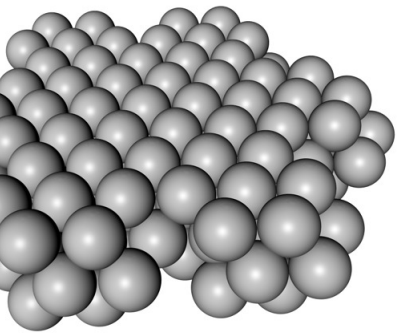
Preliminary results

Template



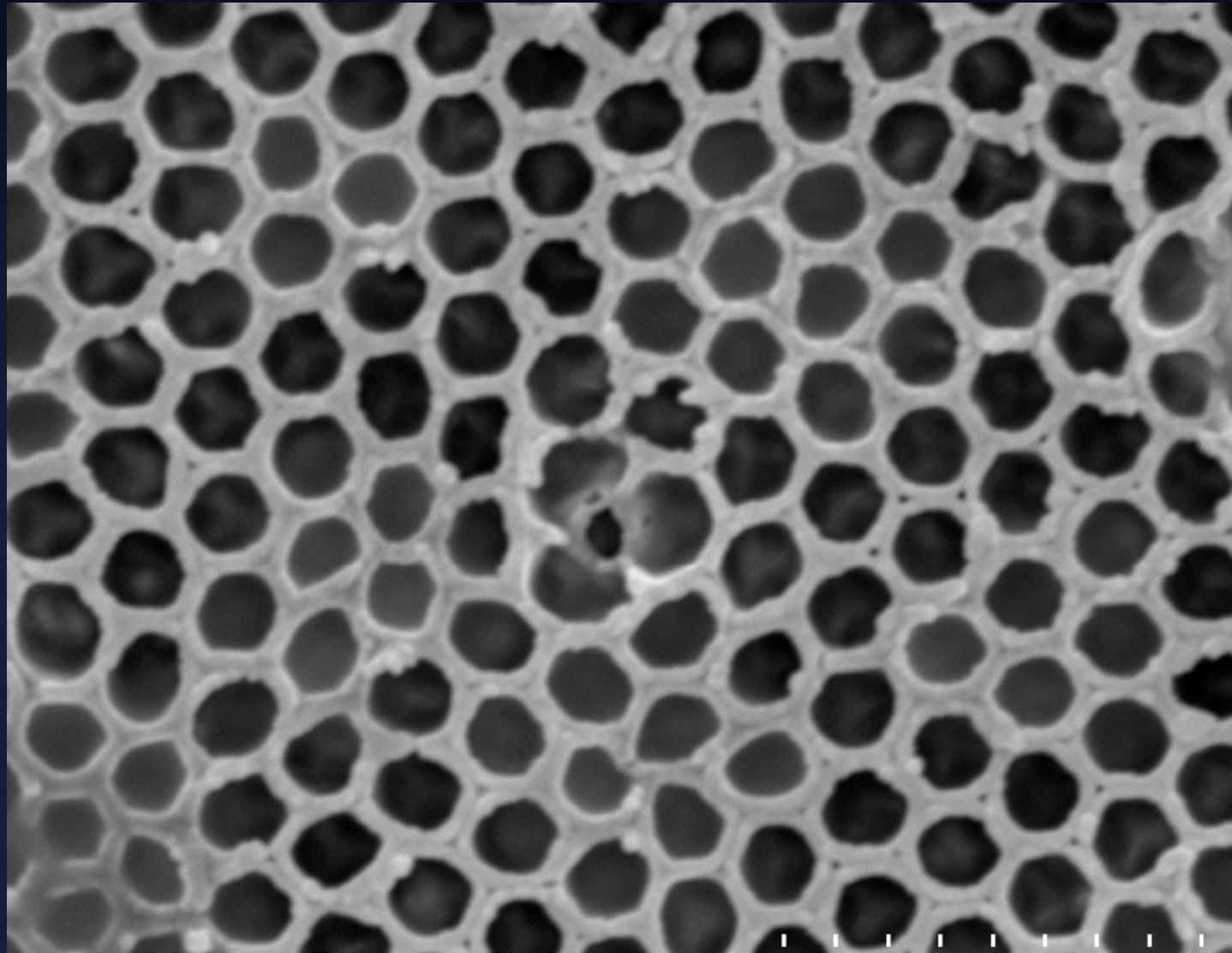
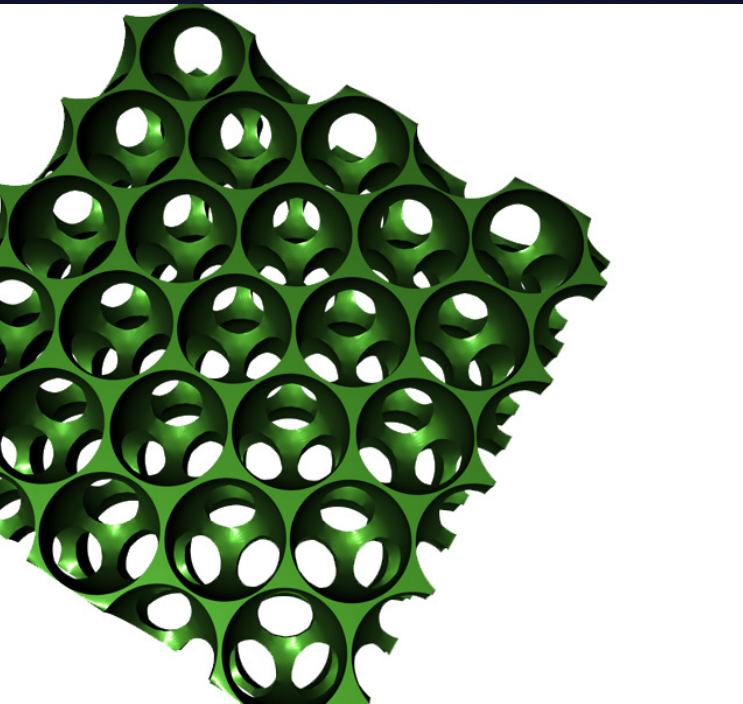
Preliminary results

Template



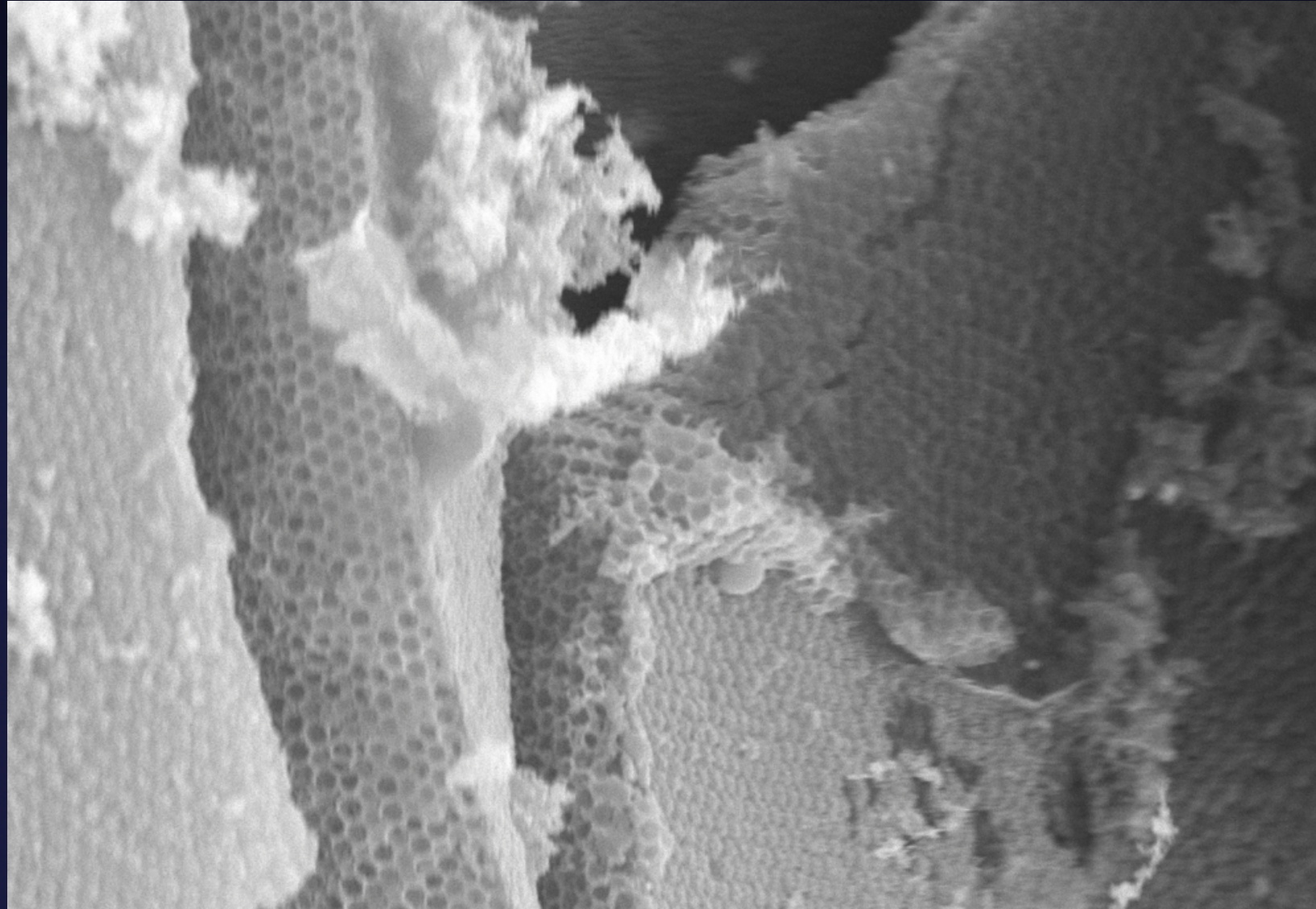
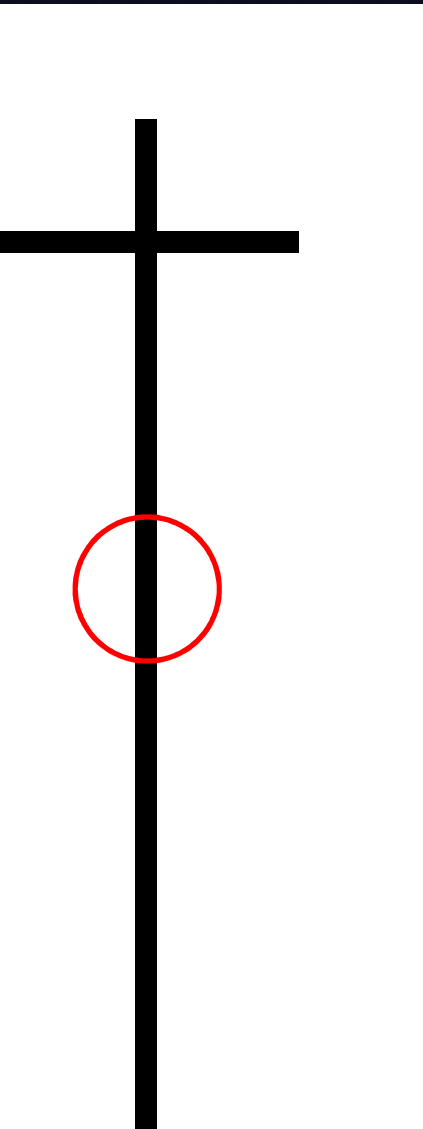
Preliminary results

Structured monolith



Preliminary results

Structured monolith



Conclusion

Controlled and reproducible growth of micro-structured monolith:

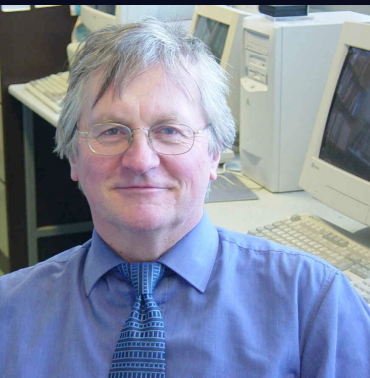
Templating

Electro-polymerization

Next step:

Do separations on the monolith to test chromatographic properties, versatility and reproducibility

Acknowledgements



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Thank you