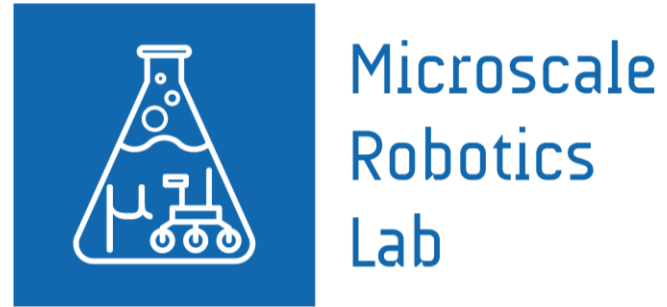


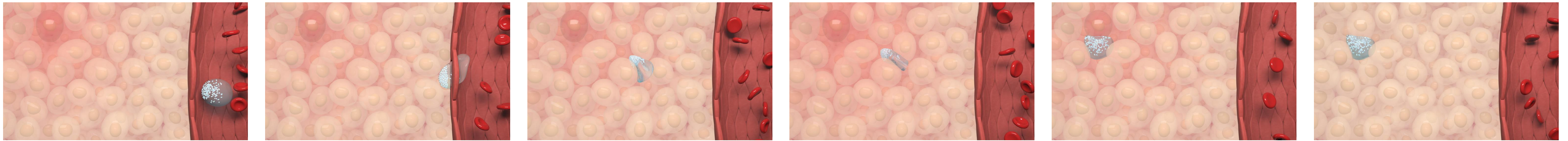
CELLOIDS: towards cell-inspired autonomous microrobots



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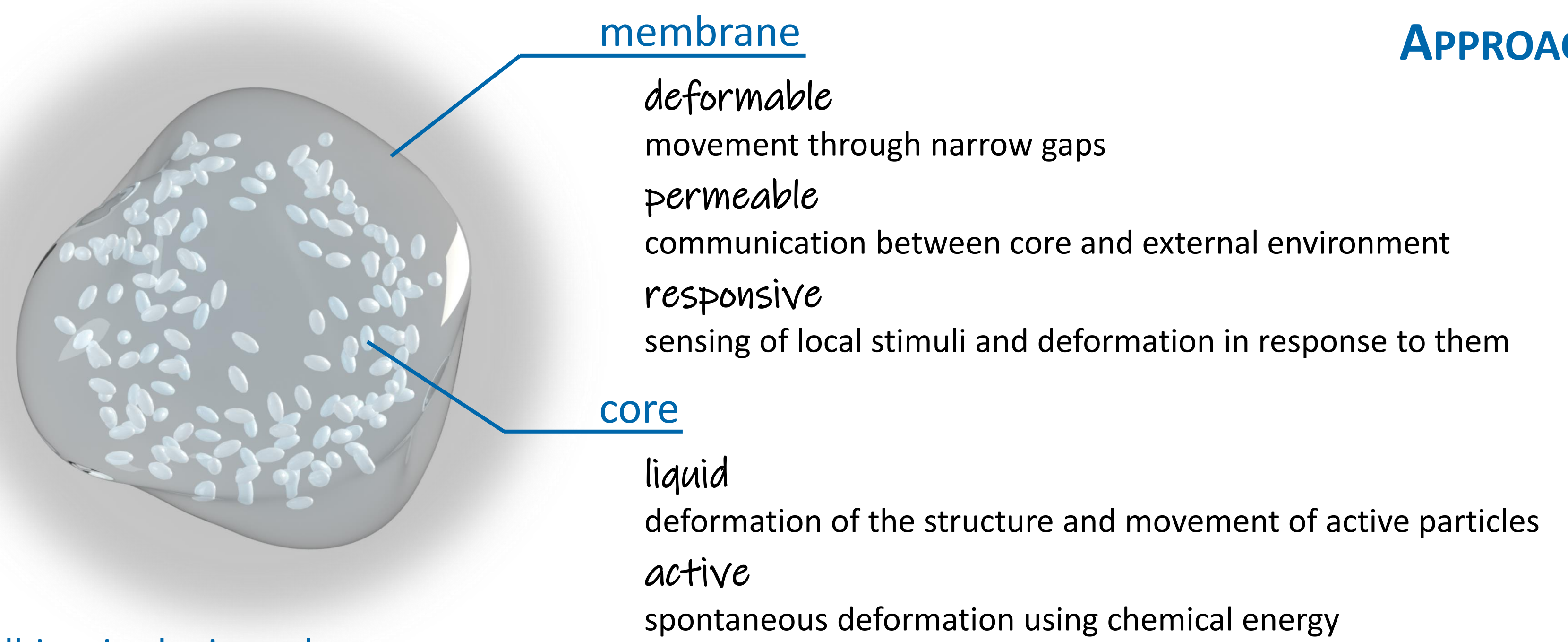
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GOAL & OBJECTIVES

mimic interstitial migration of amoeboid cells (e.g., white blood cells)
→ microrobots operating autonomously inside body tissues by

1. *adapting* their morphology to the 3D environment and move through very narrow gaps and interstices
2. *scavenging energy* from the environment to power continuous body-shape changes and movement
3. *perceiving* chemical and physical gradients in the environment and moving along them
4. *navigating* autonomously in response to locally perceived stimuli and minimal supervisory control signals



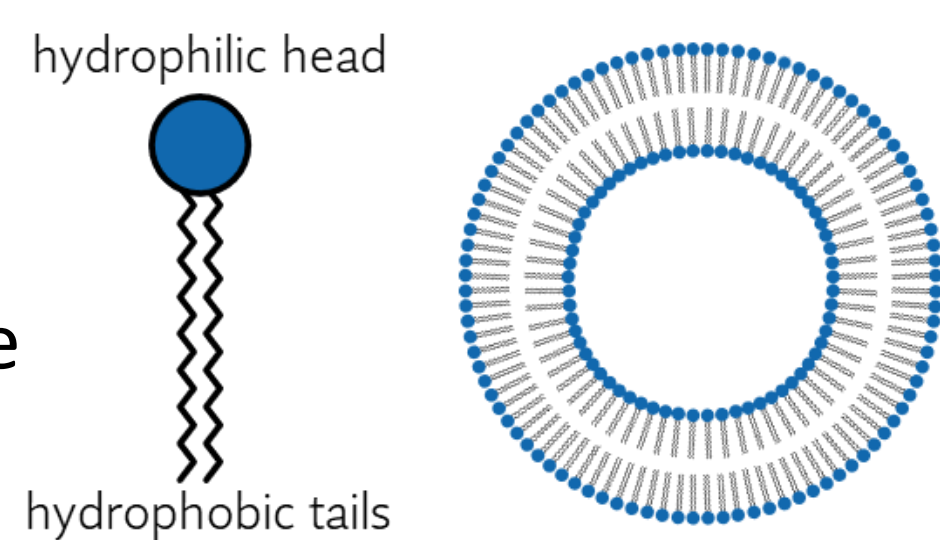
APPROACH

GUVs AS MICROROBOTS' BODIES

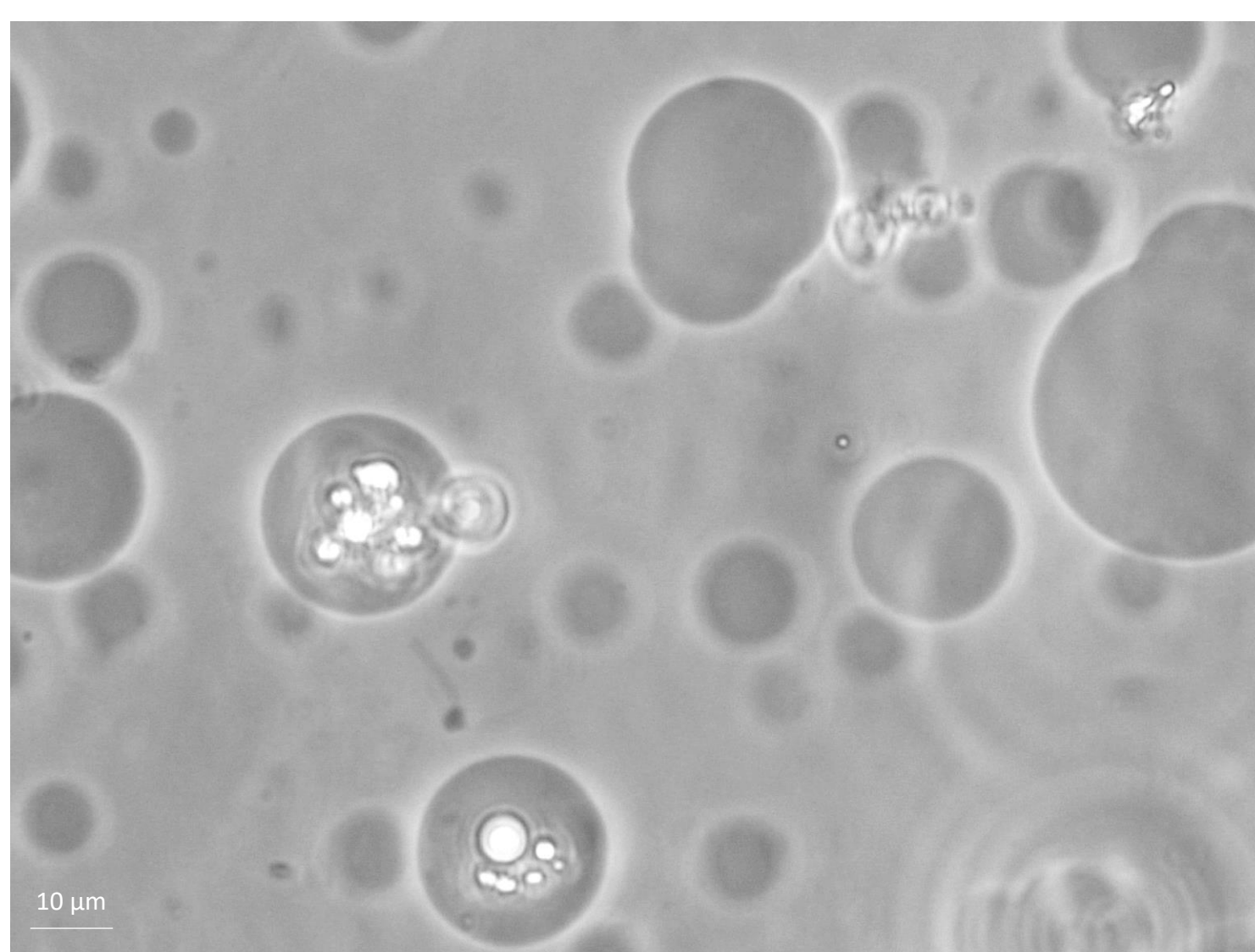
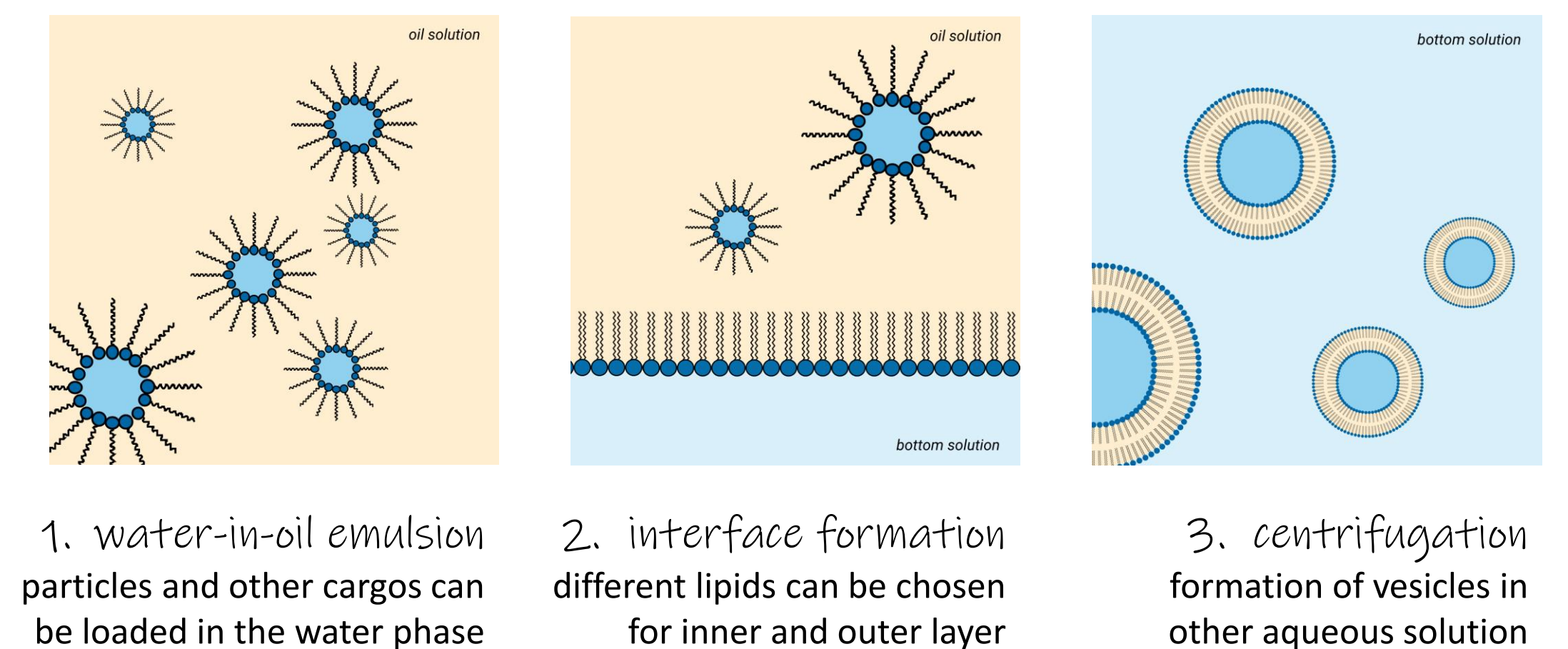
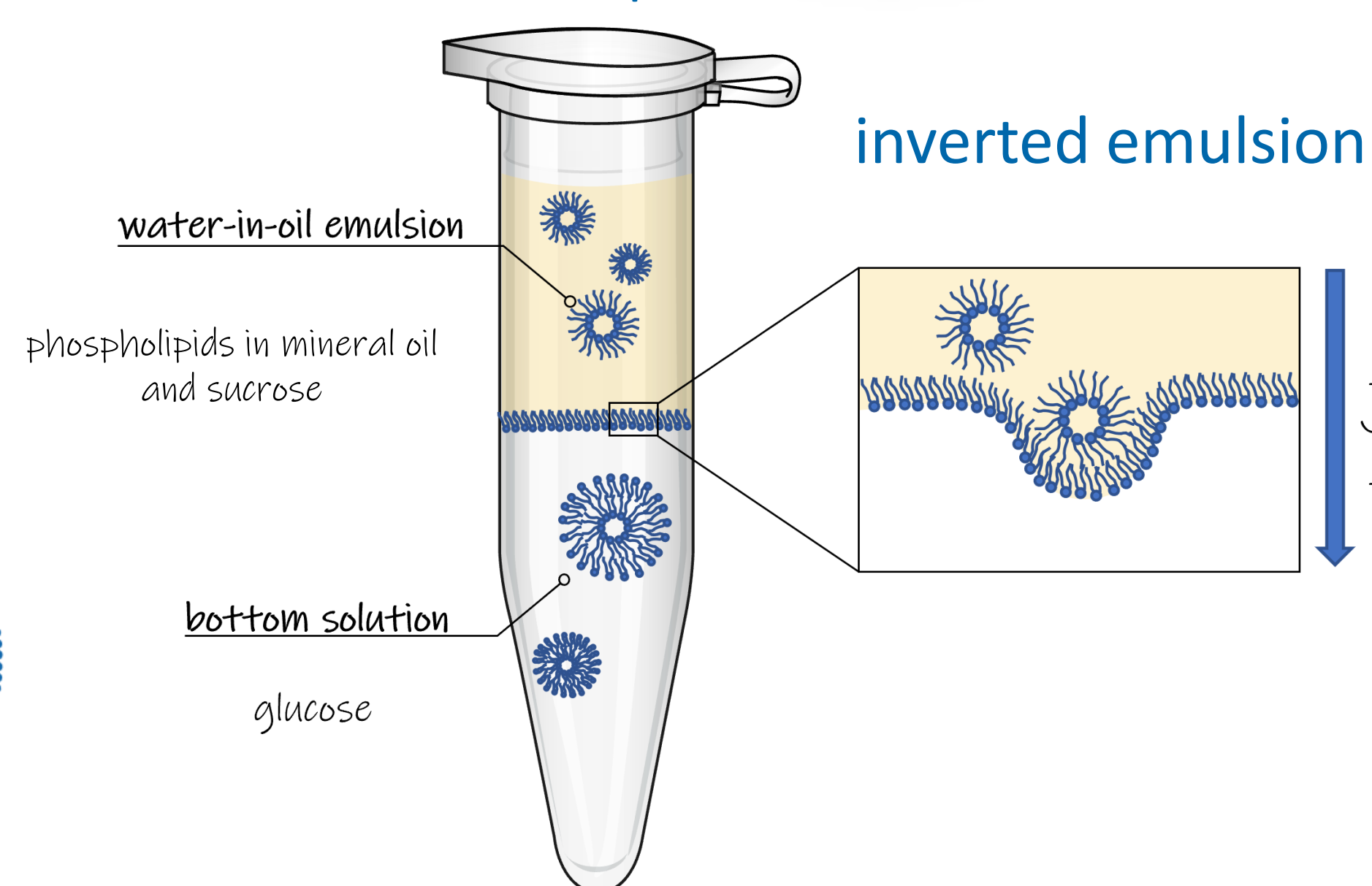
GUVs = Giant Unilamellar Vesicles

diameter $\sim 10^0 - 10^2 \mu\text{m}$
membrane: phospholipidic bilayer

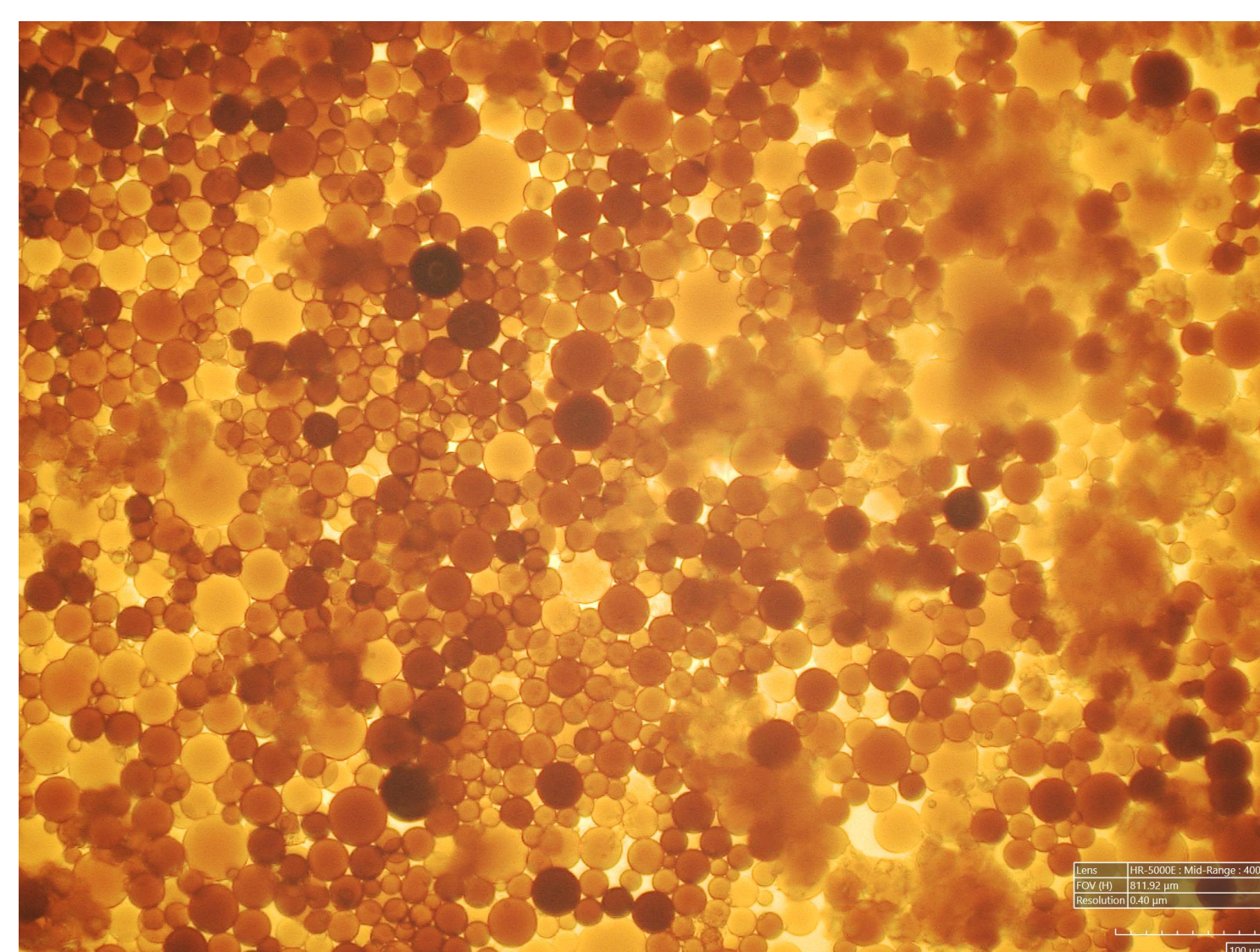
- ✓ \sim cellular membrane
- ✓ thin: $\sim 5 - 10 \text{ nm}$
- ✓ flexible & fluid
- ✓ (selectively) permeable



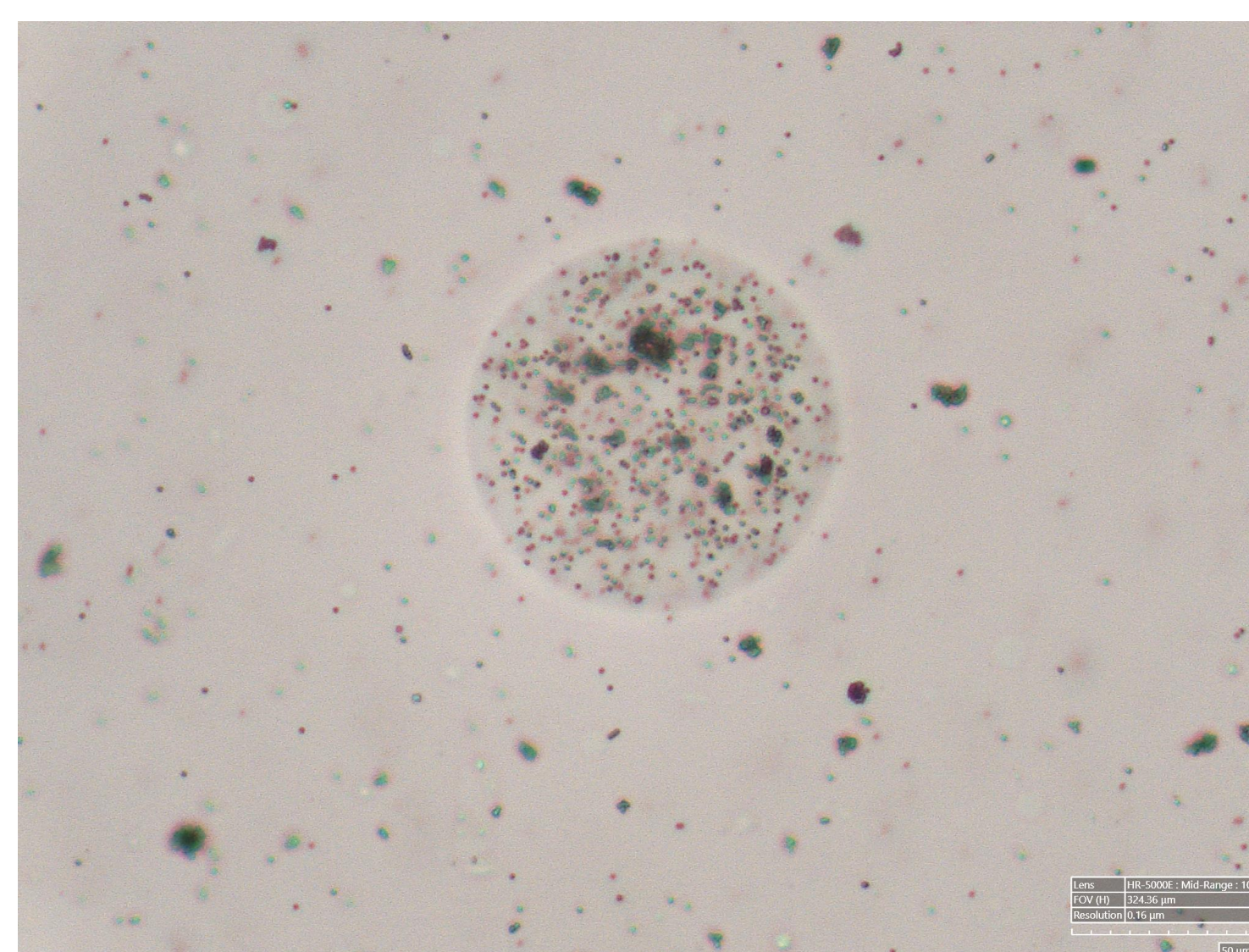
celloids = cell-inspired microrobots



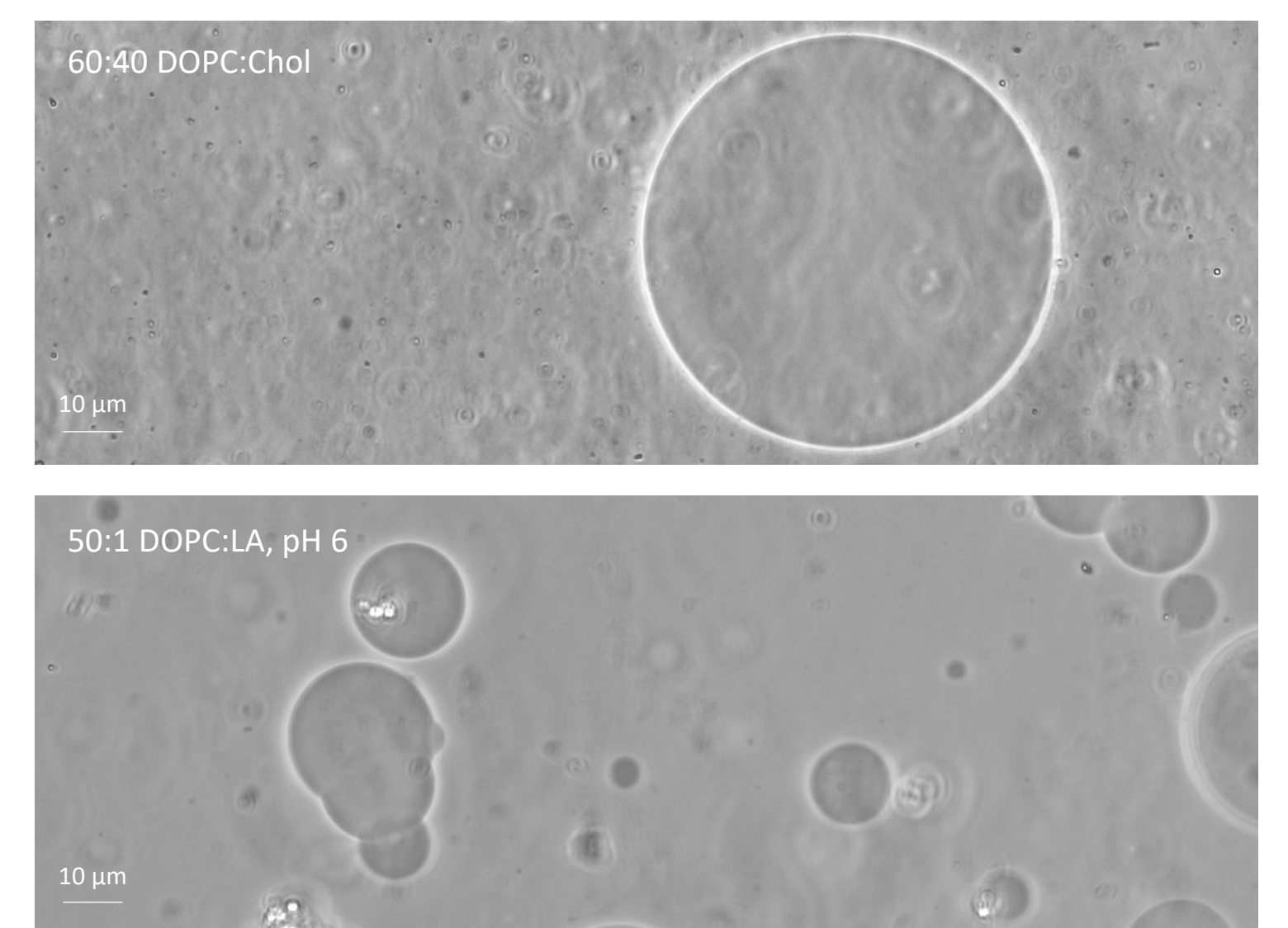
optimization of the fabrication process: reproducibility, dispersity



loading with ferrofluid → ultra-soft magnetic microrobots



loading with particles

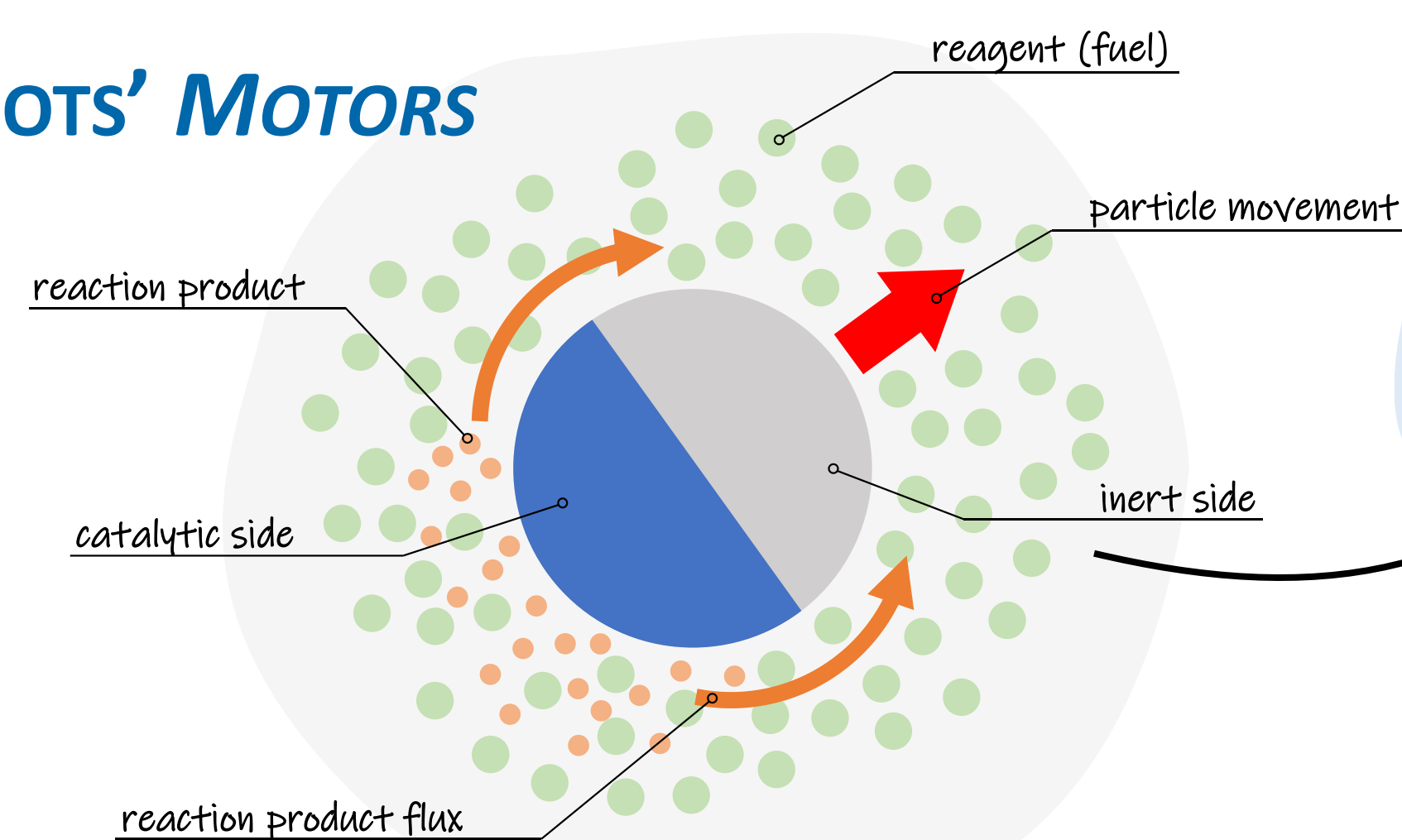


stability, deformability, responsiveness

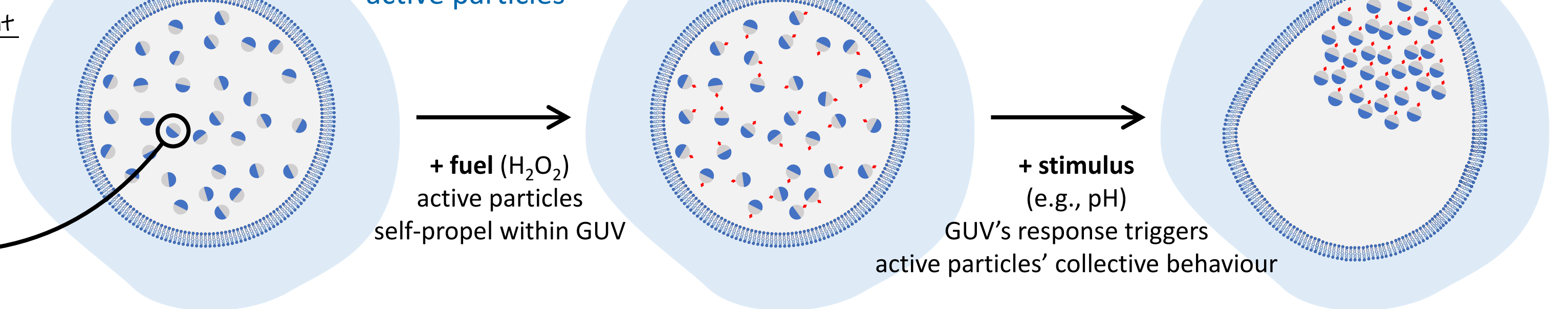
ACTIVE PARTICLES AS MICROROBOTS' MOTORS

self-propelled catalytic microparticles

diameter: $1 - 3 \mu\text{m}$
inert substrate: SiO_2 or PS
catalytic layer: Pd or Pt
fuel: H_2O_2 ($\leq 5\%$)

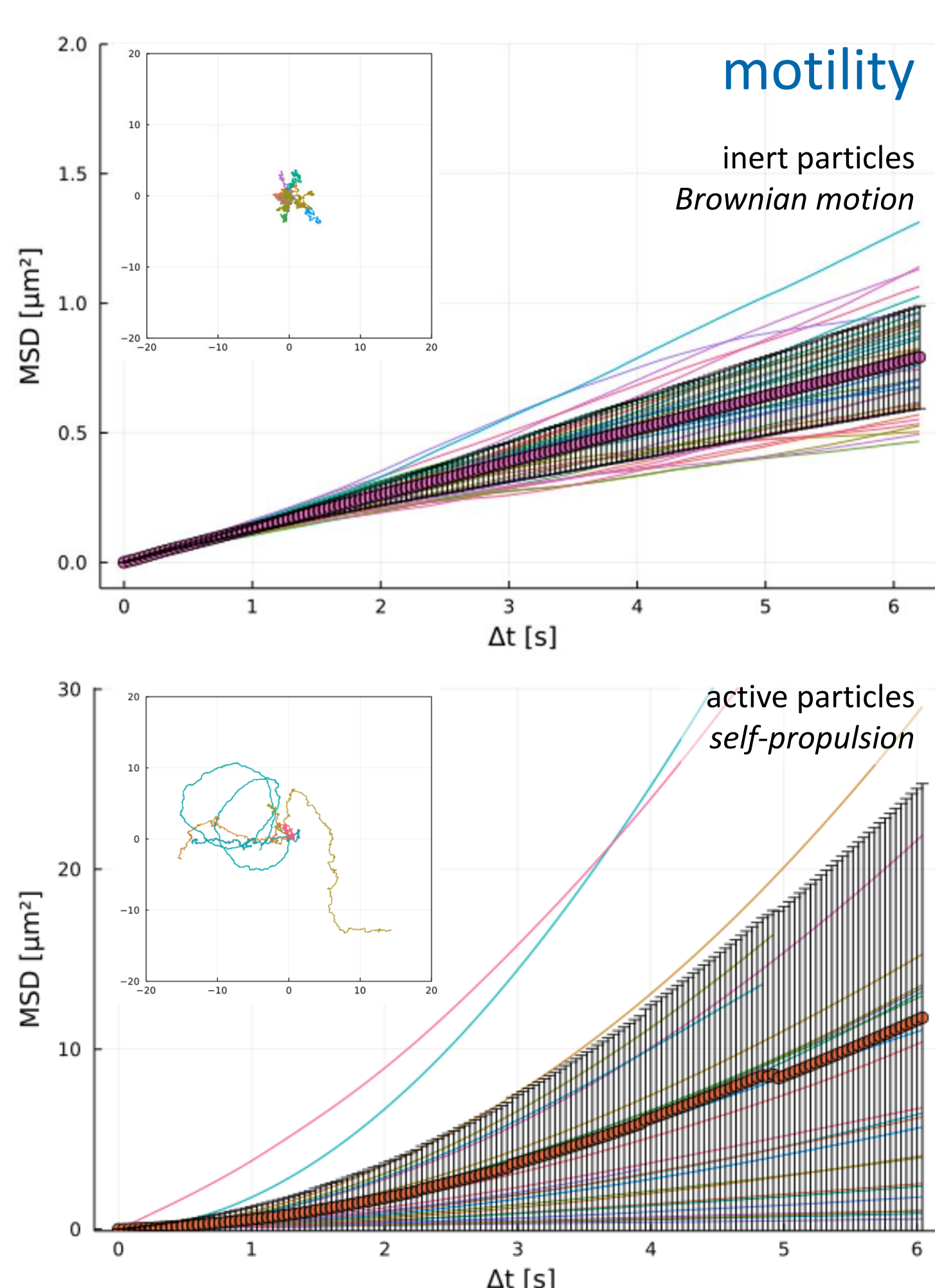
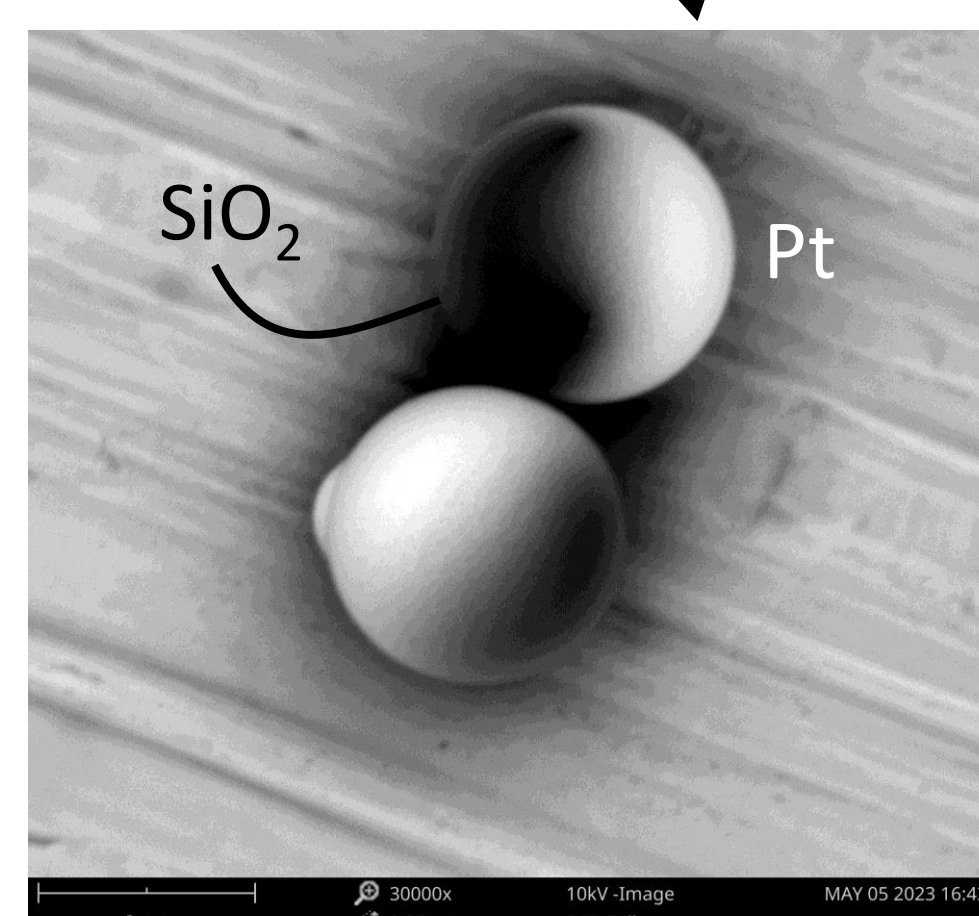
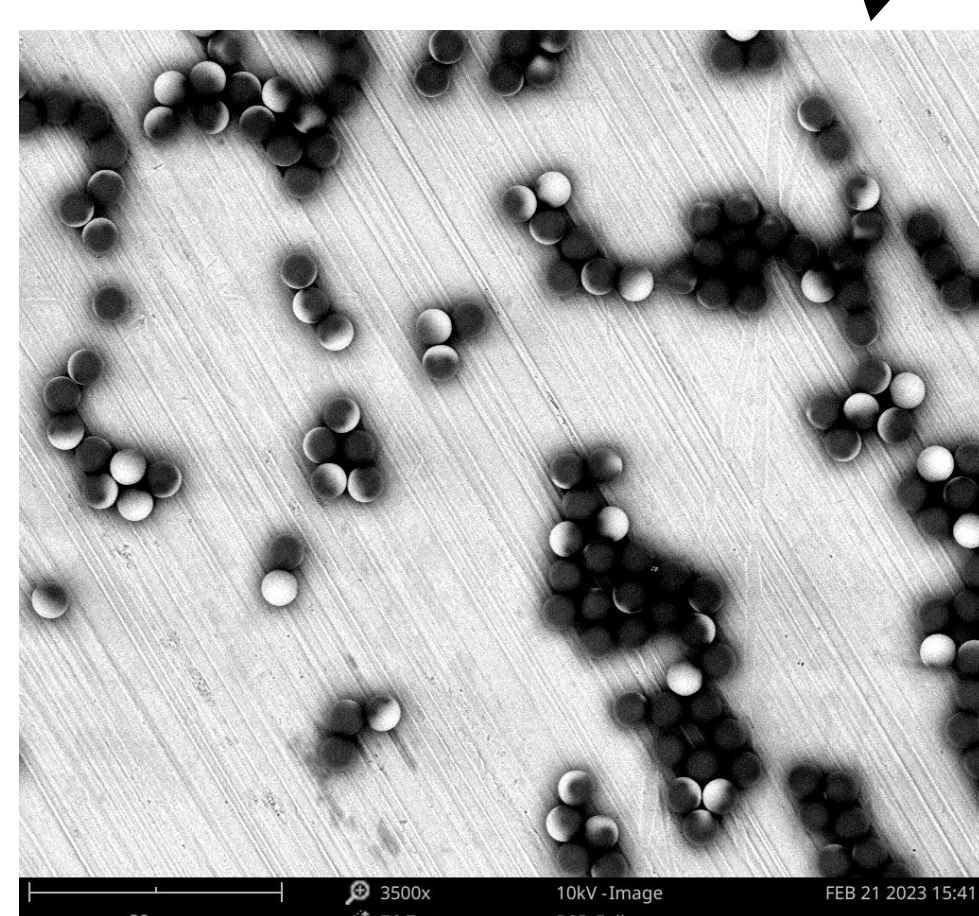
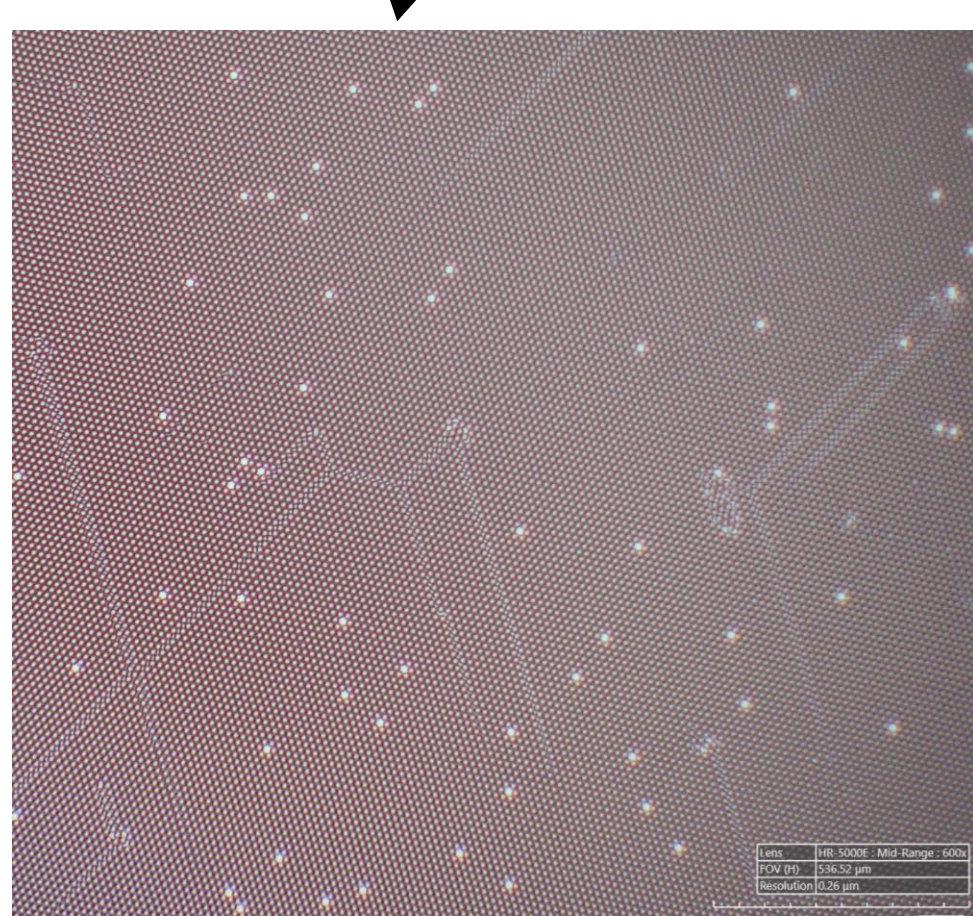


microrobot =
responsive GUV containing
active particles



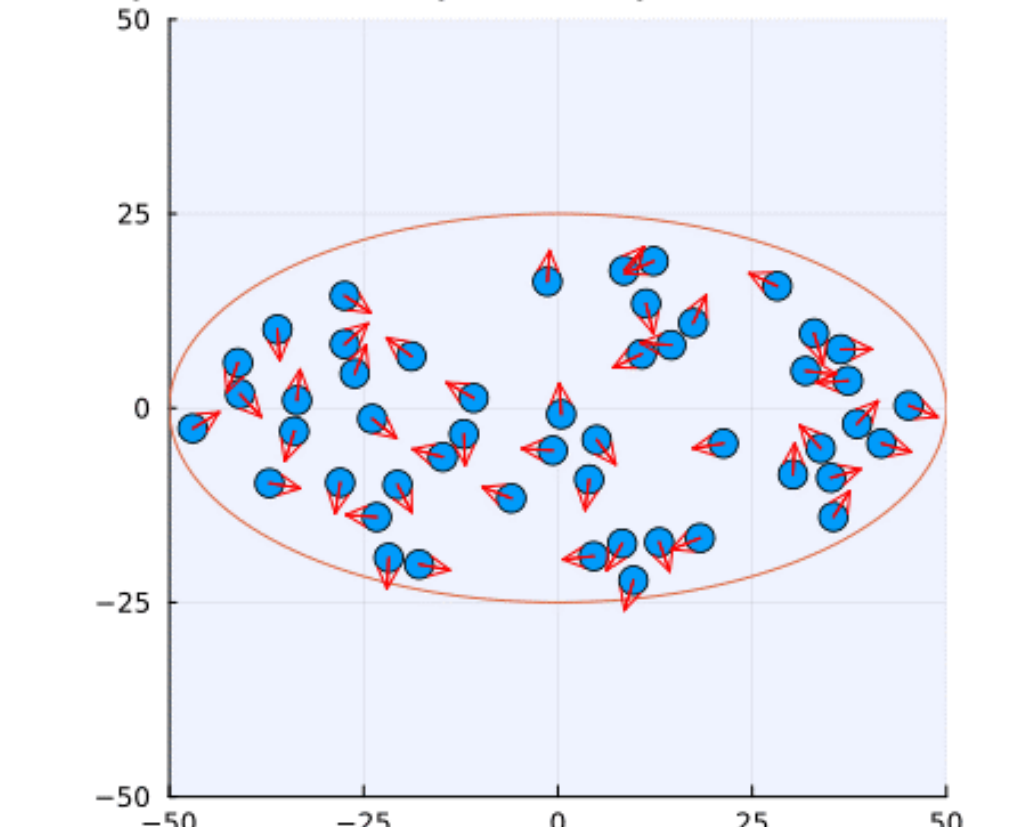
monolayer formation + catalyst deposition

1. drop-casting
of inert particles
2. sputter coating
of particles' monolayers
with catalyst

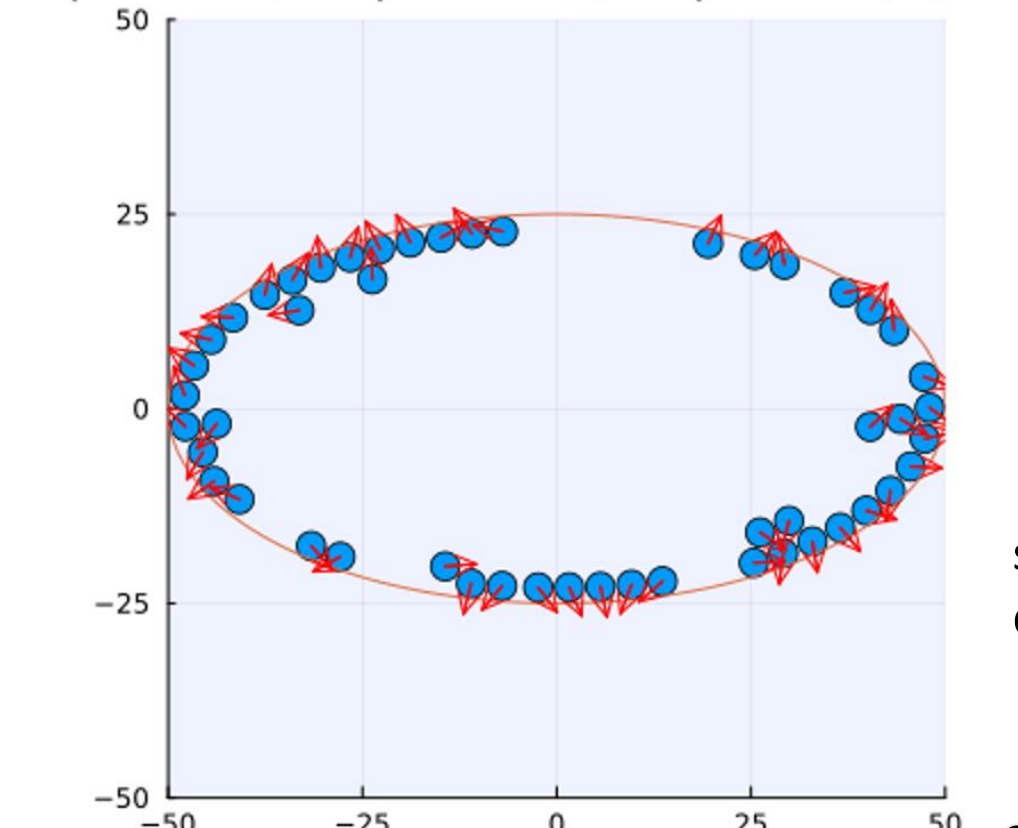


collective behaviours in confinement

50 particles, steps 1, ellipse $a=L/2$, $b=L/4$



50 particles, steps 30701, ellipse $a=L/2$, $b=L/4$



simulations
done in
julia



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