

Sperm-driven microrobots: Prospects

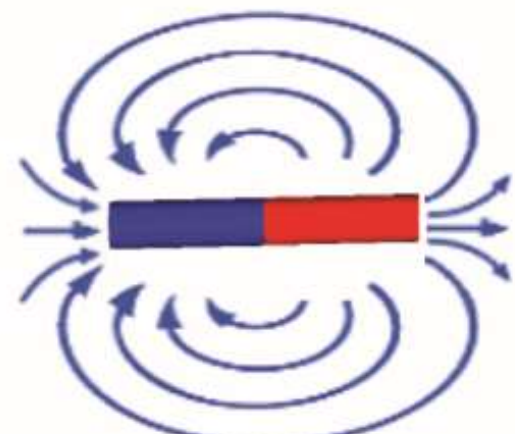
Micro-Bio-Robot
Motile Cell + Microtube = Robot



Watch Video



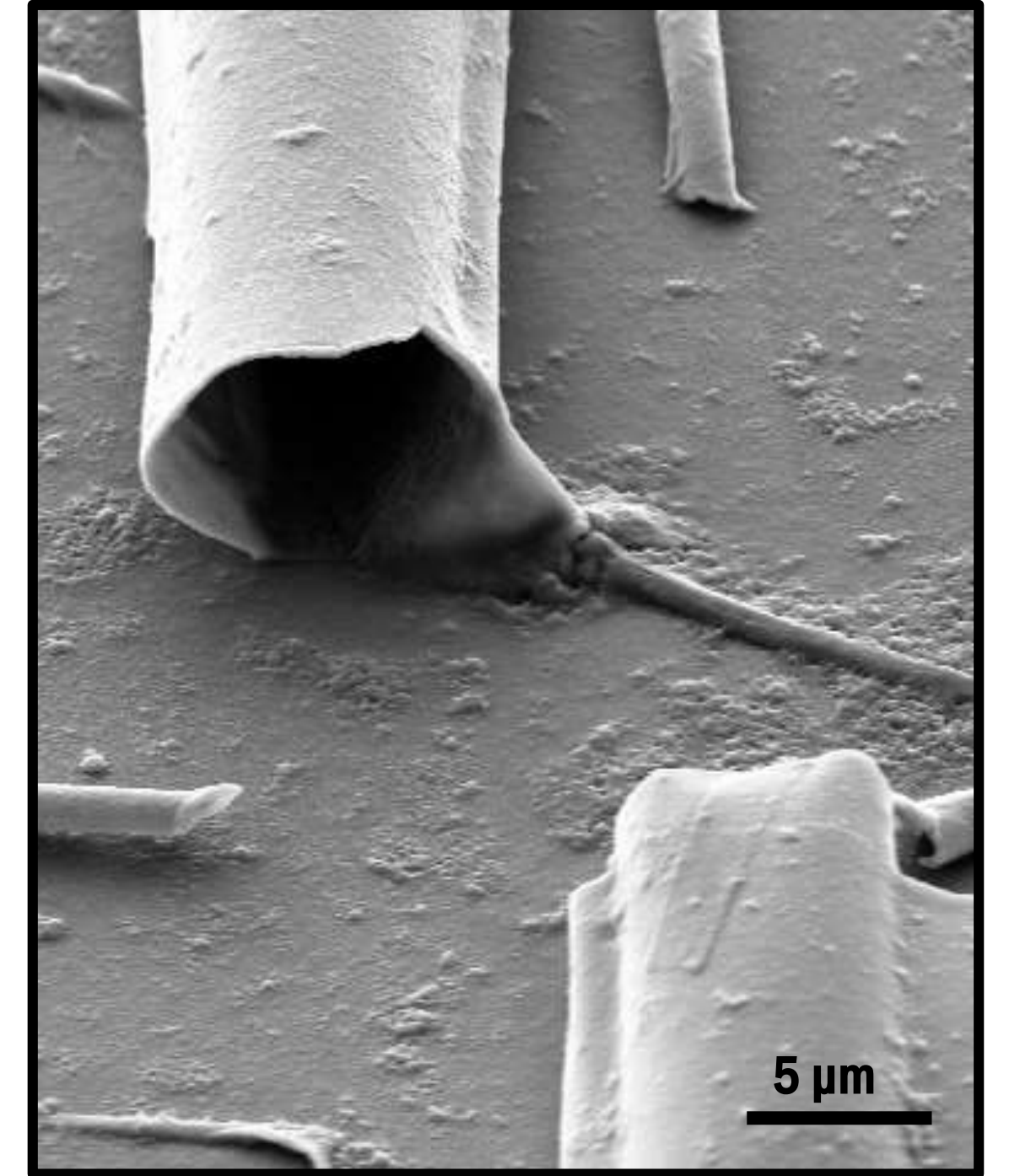
Capture



Remote Control

Autonomous delivery of cargo, such as

- Sperm cells
- Drugs
- microRNAs, proteins, etc.
- Sperm cell manipulation (direction & speed)
- Innovative assisted reproduction techniques
- Explorative tools for sperm migration studies



WHY?[4]

- Flagella as powerful actuation
- Biocompatible
- Actuation in body fluids
- Smart sensing
- Taxis
- Easily available

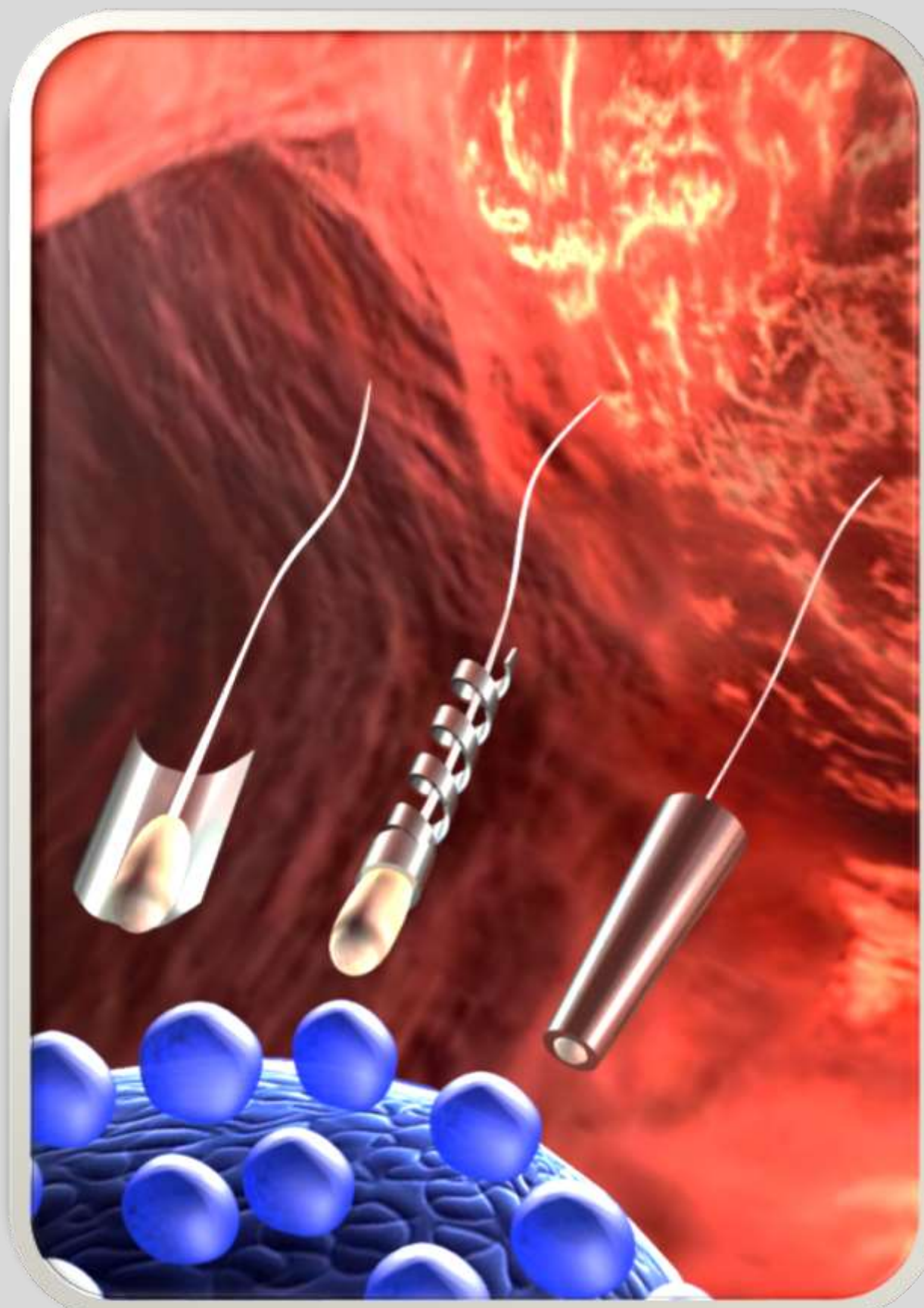


Image source [4]

WHY NOT?[4]

Imaging

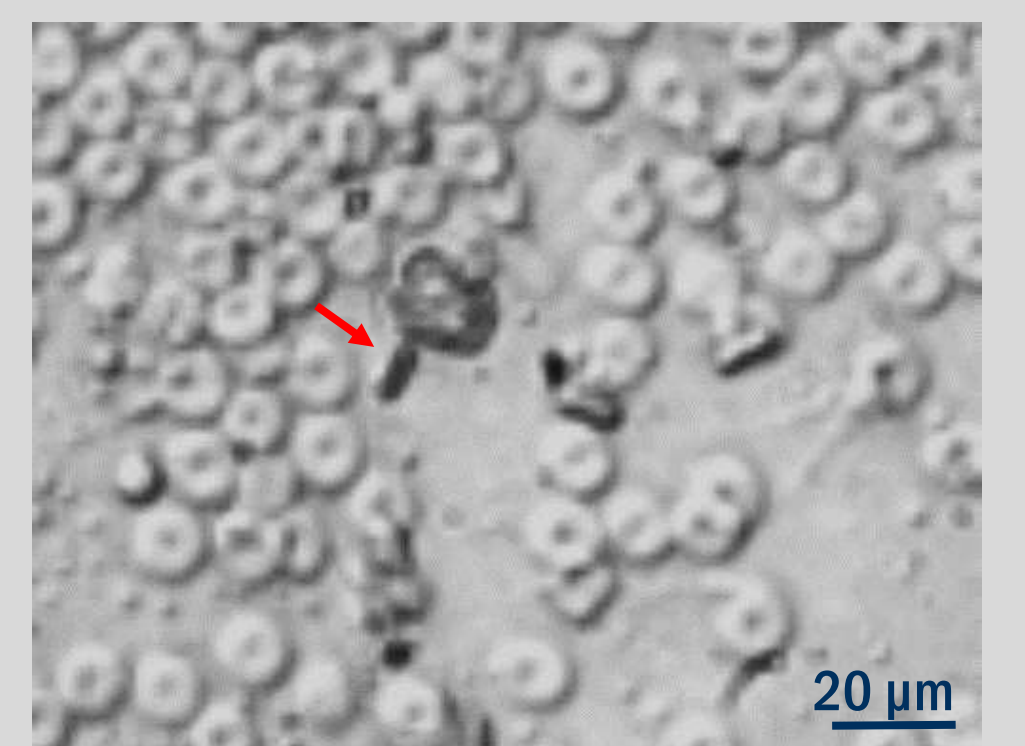
Current techniques lack resolution
Possible Approaches (Liposomes, Qdots (MRI), Nanoparticles (MRI))

Challenges

Controlled capture

Currently random tracking of sperm cells, no selection of cells

Immune response

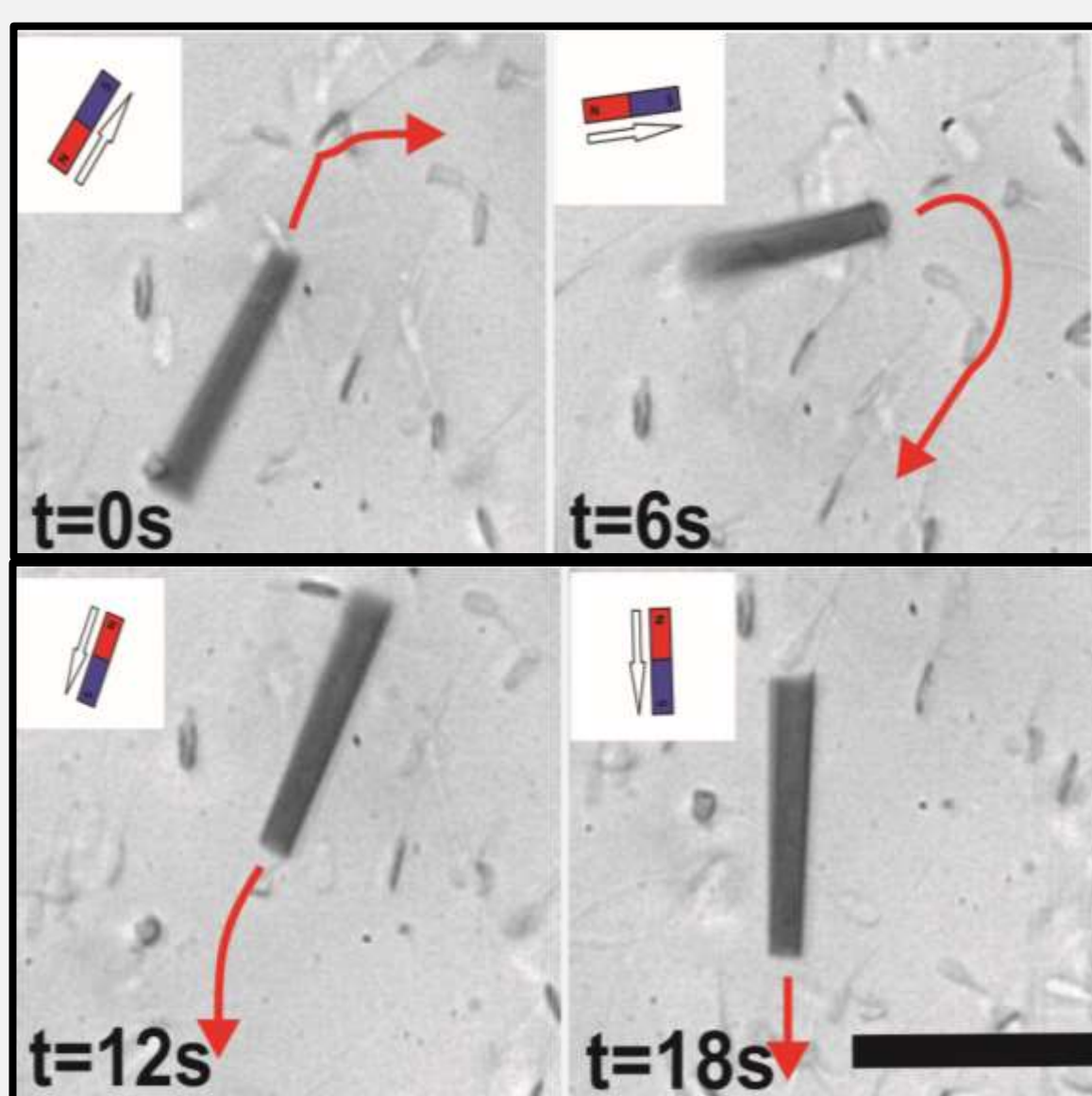


Bull sperm attacked by white blood cells
Image credit: B. Eckel, V. Magdanz

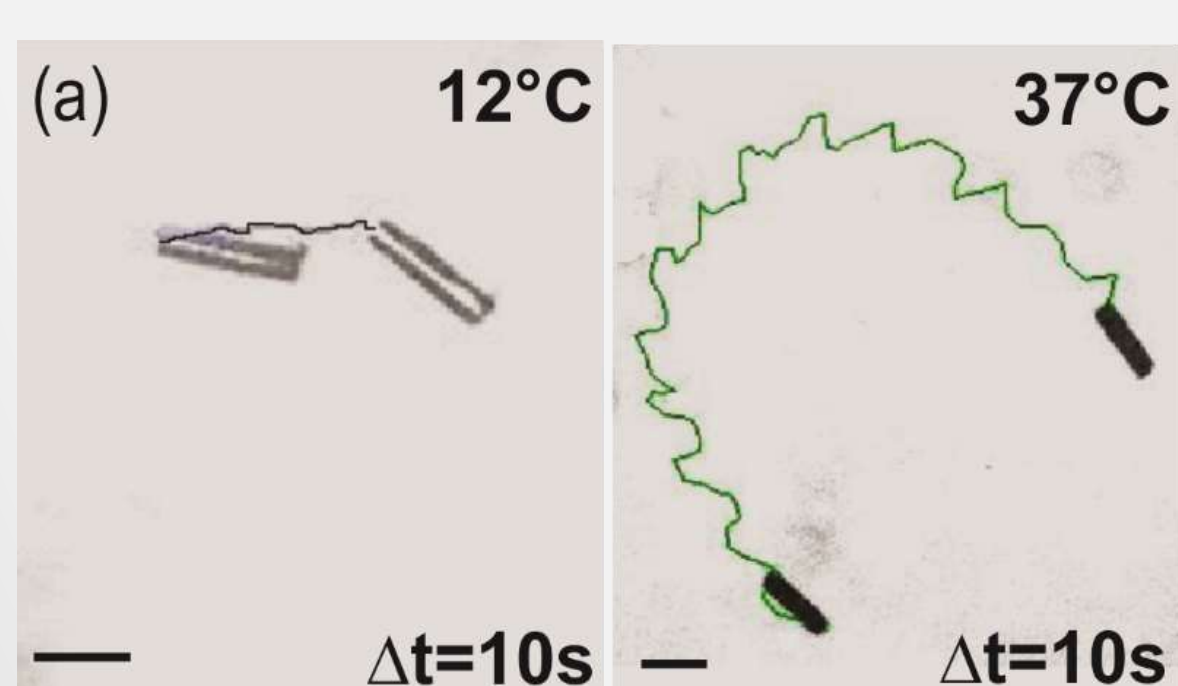
Ethical concerns: Sperm robots swimming in the human body?

What has been done so far...

Directional control by magnetic fields^[1]

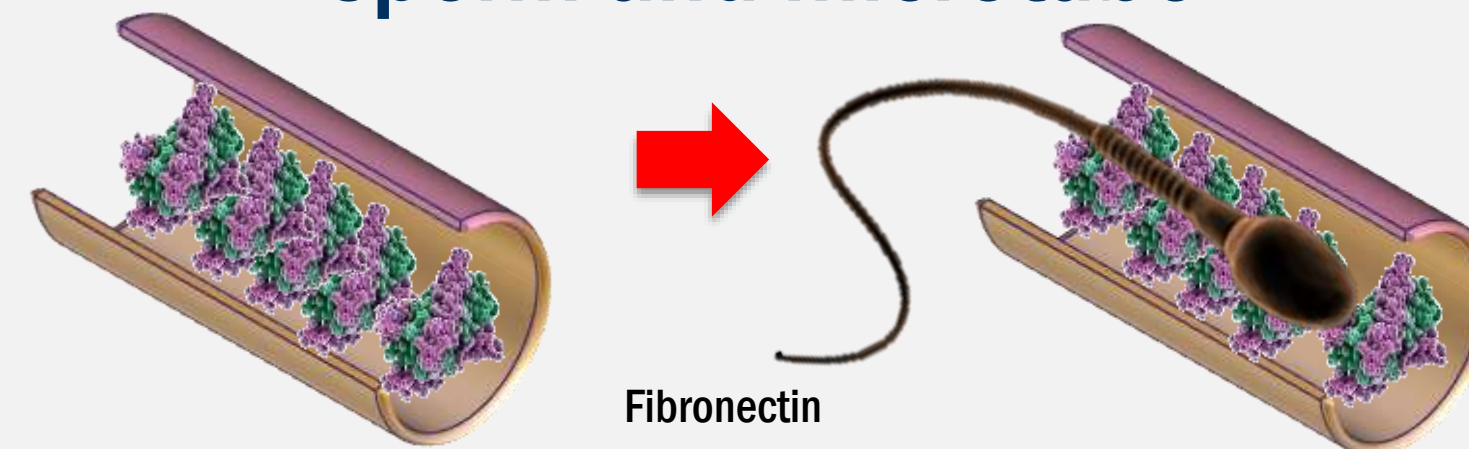


Speed control by temperature^[1]

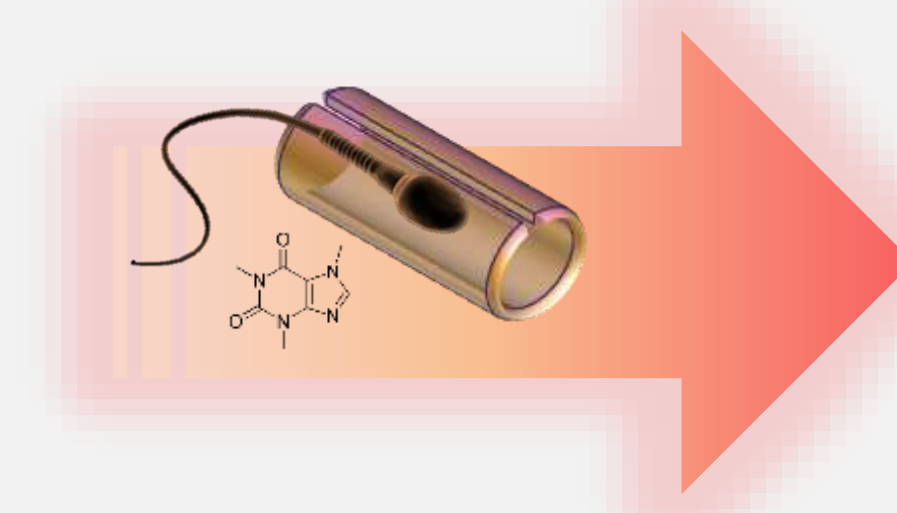


Improved performance^[2]

1. Fn for improved coupling between sperm and microtube



2. Speed boost by caffeine

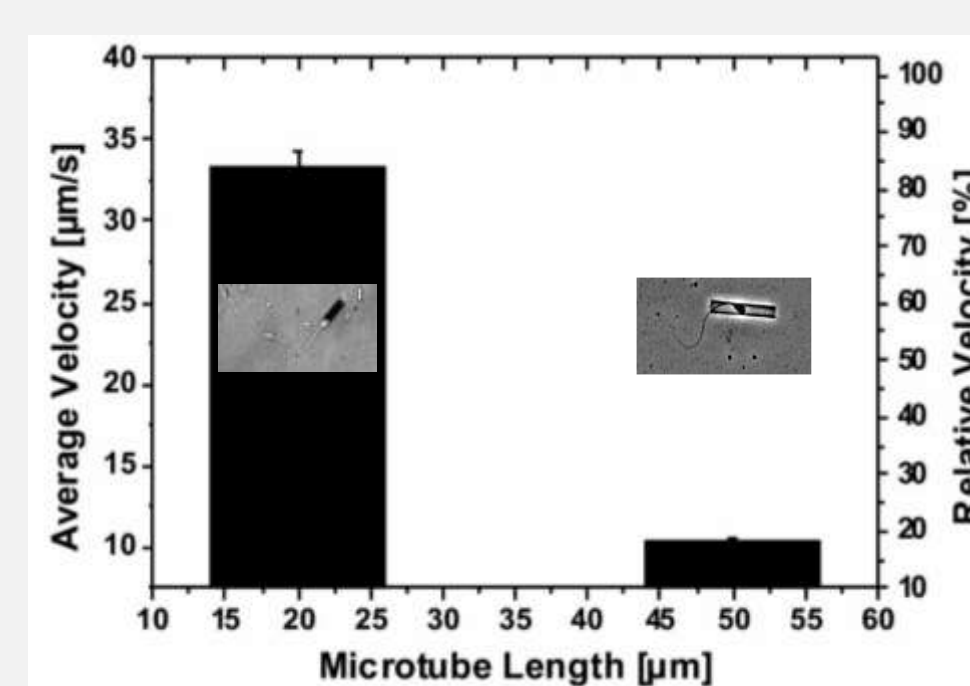


3. Shorter tubes makes them swim faster

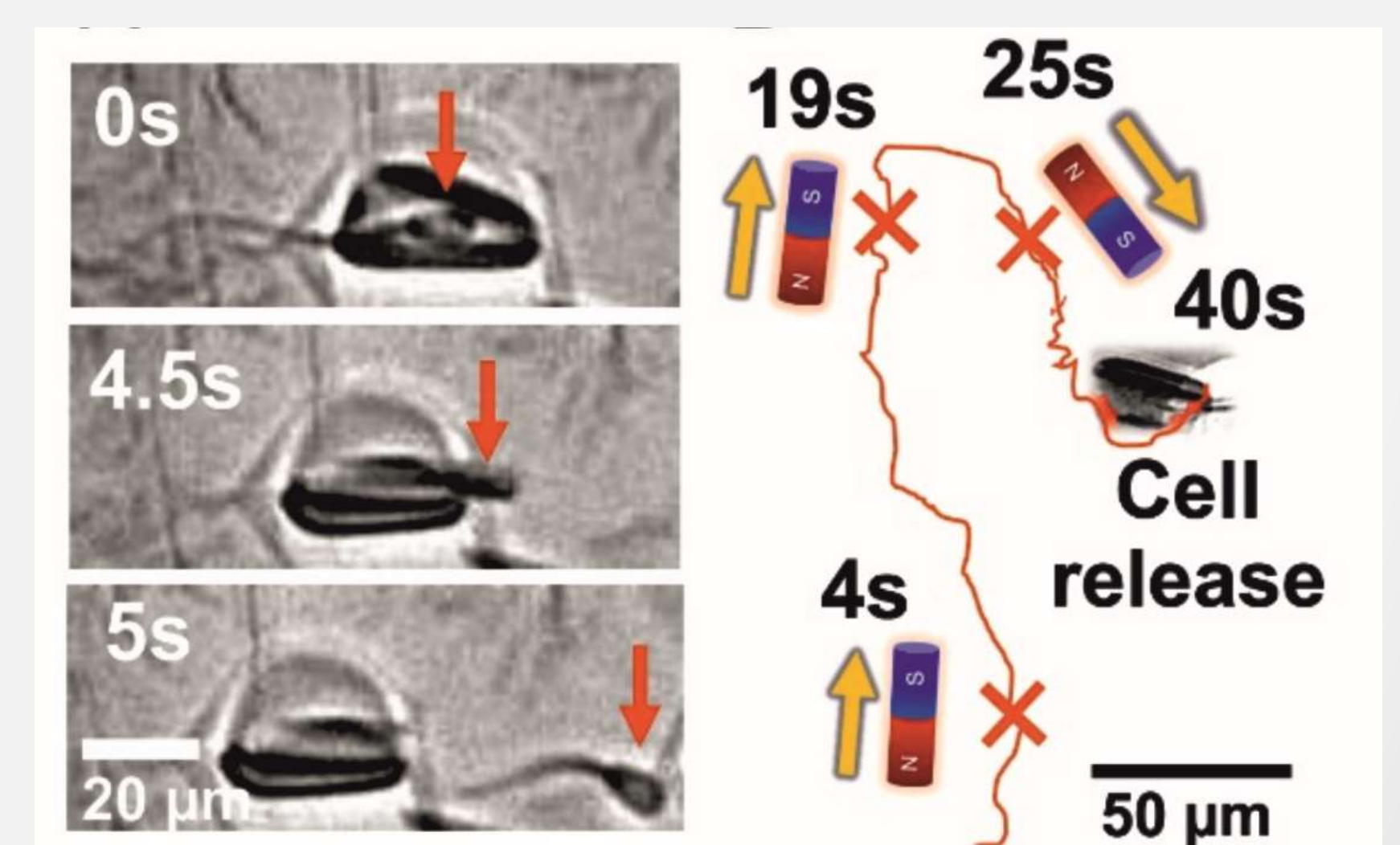
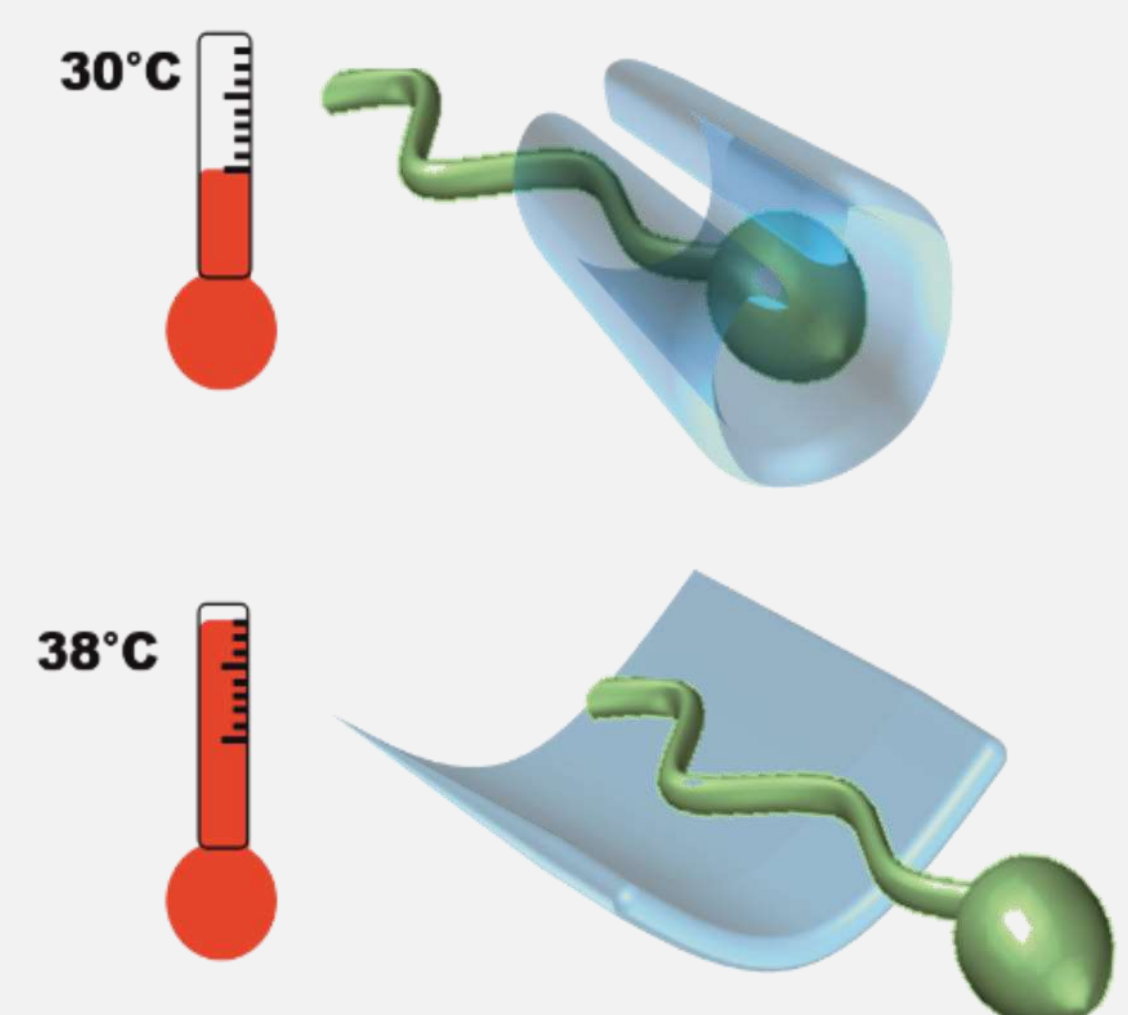
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Shorter microtube



Thermo-triggered release^[3]



Conclusions

Sperm cells are promising as biological components of microrobots

We need to learn more about how they function in order to optimize their integration and explore their sensing abilities and control mechanisms