

Liquid crystals for advanced life sciences and imaging

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Liquid crystals for advanced life sciences and sensing (imaging)

The goal of the laboratory is to create a technological platform for new imaging and probing technologies, which are first used in biotechnological applications, followed by broader consumer photonics applications. We are conducting academic and applied research in the field of biotechnologies by using lasers and liquid crystal materials.

The adaptive imaging portion of our work will have special practical significance, as its results will also be used in robotics, autonomous vehicles, drones, and satellites.

Development of new sensing methods for monitoring biological functions (e.g., “mobile” microscopes, guided wave probes for local sensing of neural activity). The anticipated academic outcome is the new knowledge about the processes undergoing in the human brain.

The anticipated practical outcome is the creation of photonic sensing tools (including adaptive imaging), which may be used in biomedicine, but also in robotics, drones, etc.

Team and Cooperations

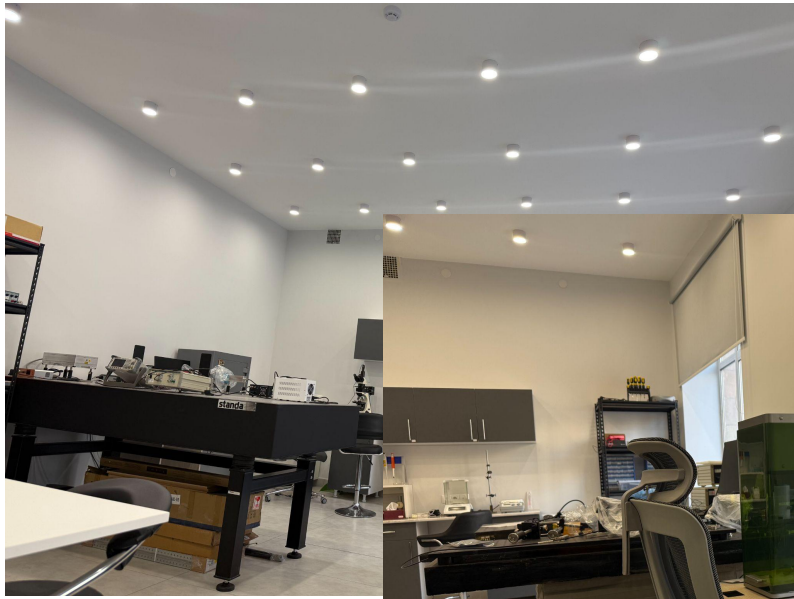


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Laboratory and office room

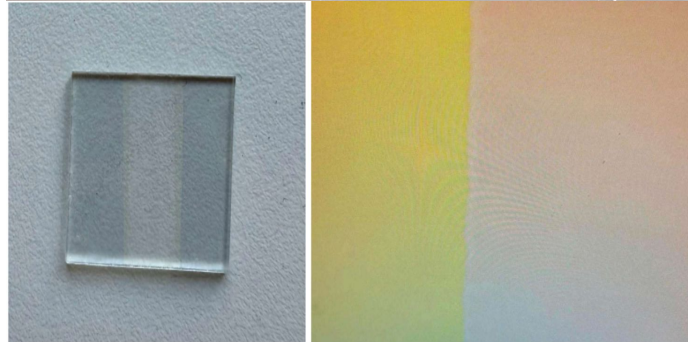
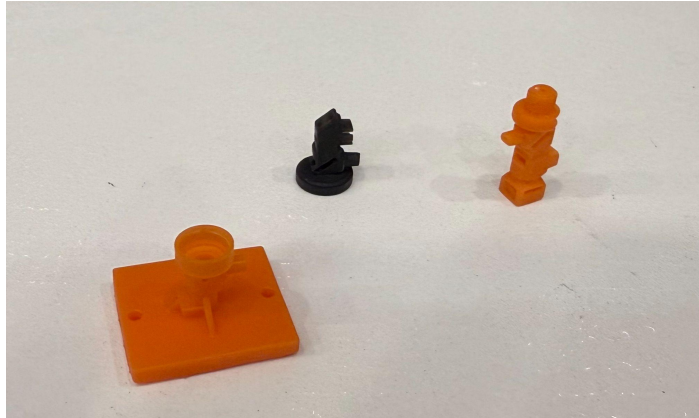


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Equipment

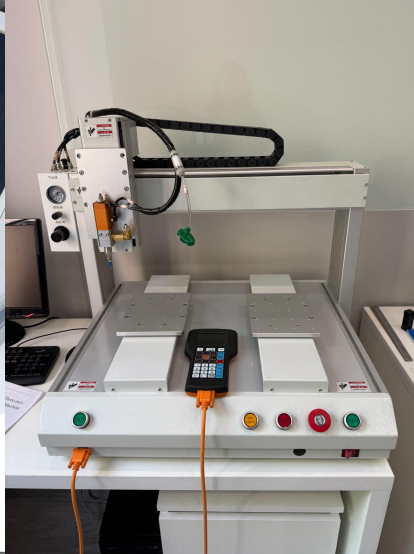


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Equipment



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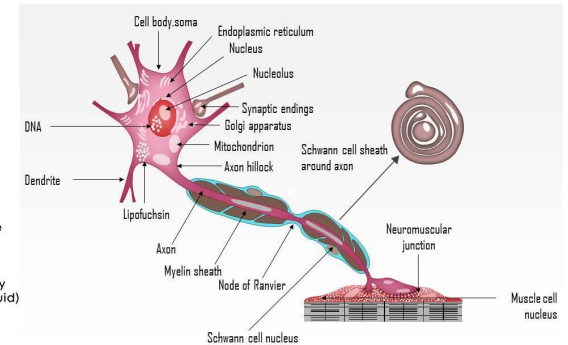
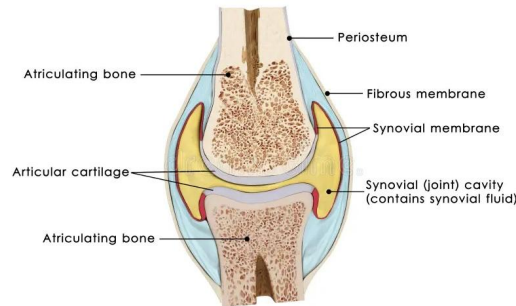
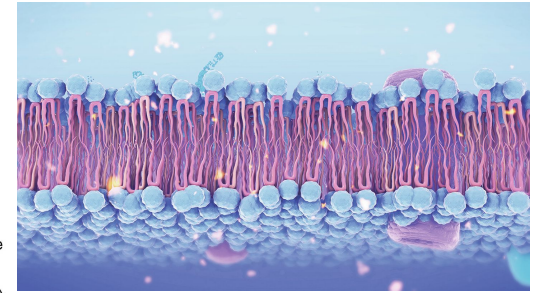
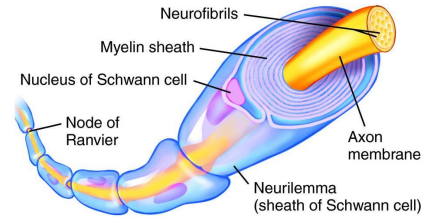


Liquid crystals

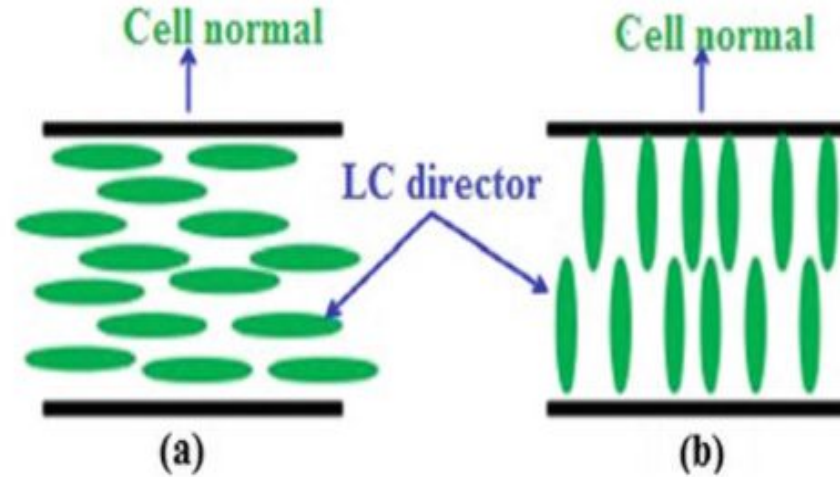
- Cell membrane
- Synovial fluid
- Mucus
- Myelin
- Biofilm-like bacteria aggregates.
- Solutions of chitin, collagen or short DNA chains
- Spider network

Solid or non biological

- Display
- Soap
- Beetles cuticles
- Bullet proof Jacket

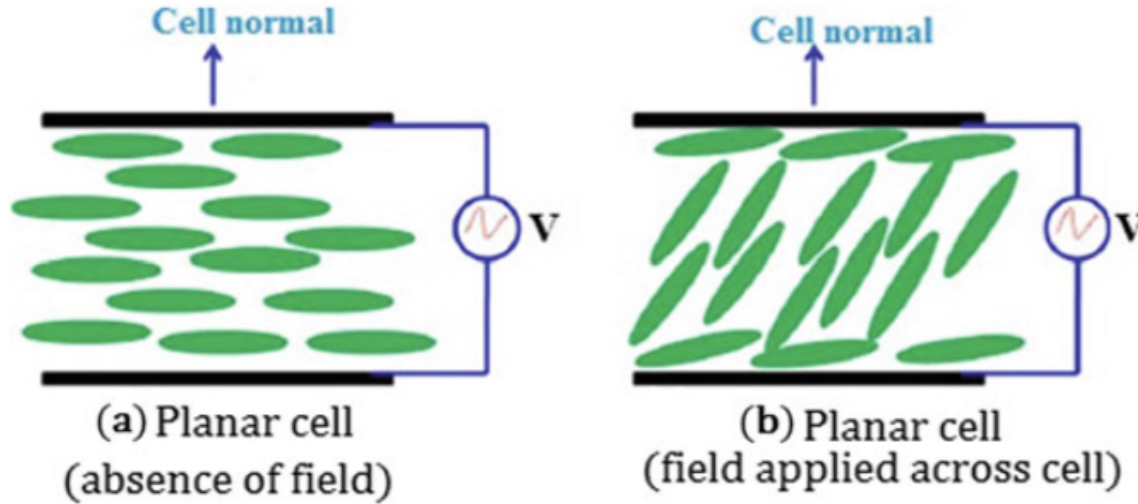


Liquid crystals



Navigation icons: back, forward, search, etc.

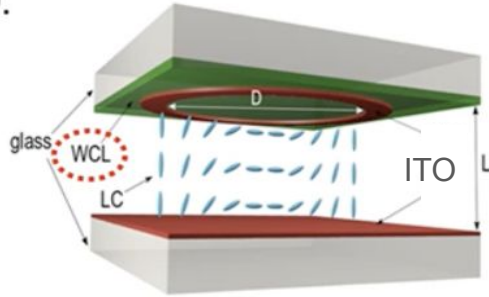
Schematic diagram of Freéderichsz transition, cell has planar alignment



Freéderichsz effect. For $E < E_{th}$ no reorientation is observed, while for $E > E_{th}$ reorientation begins, starting from the center of the sample, where the restoring torque exerted by the elastic forces is weaker.

Liquid crystal lens

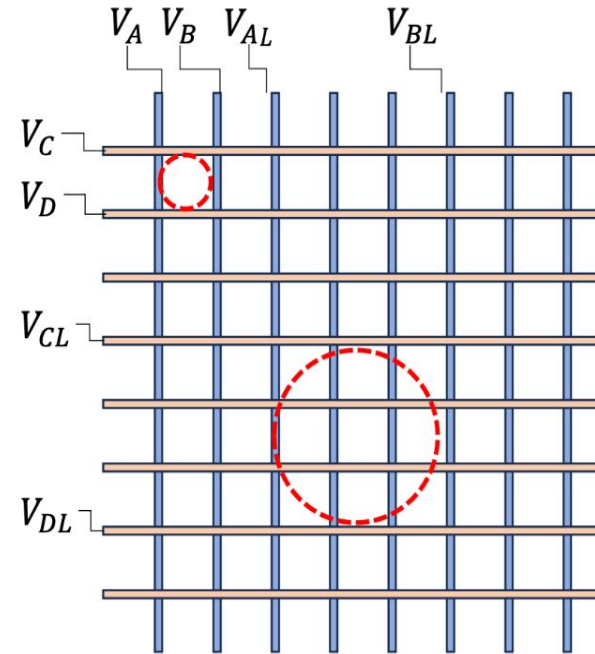
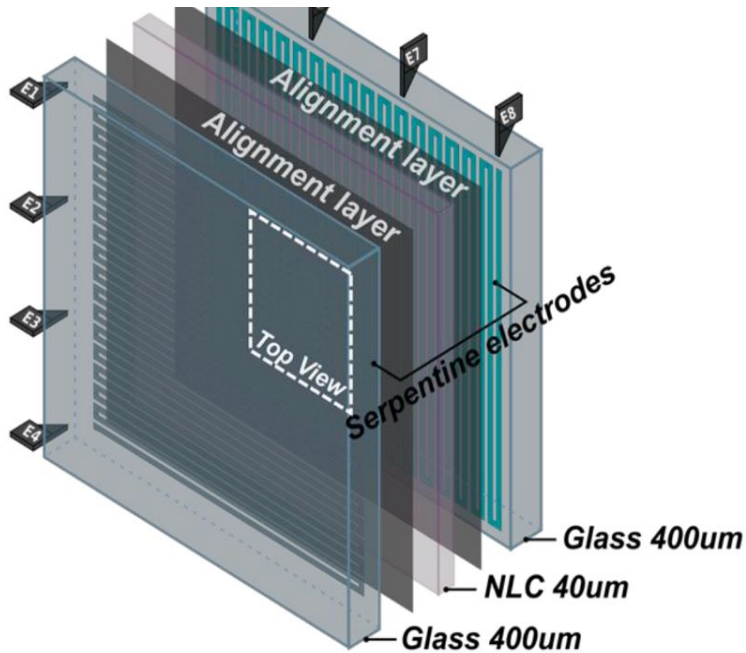
Sato, S., Japanese Journal of Applied Physics, 1979.
18(9): p. 1679.



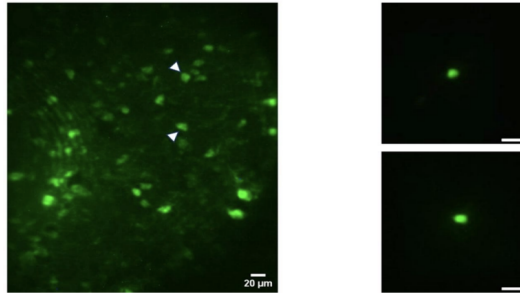
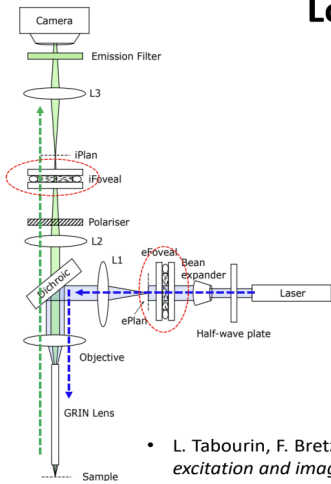
F. Kahn, Electronically variable iris or stop mechanisms, 3,741,629, 1973.

A.F. Naumov, M.Y. Loktev, I.R. Guralnik, G. Vdovin, Optics Letters, 1998. 23(13): p. 992-994.

Almost continuous array of lenses

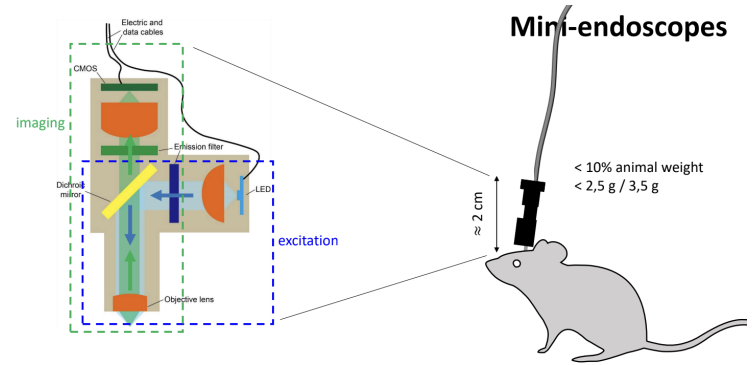
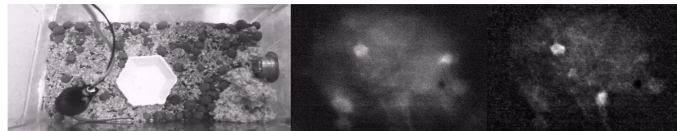
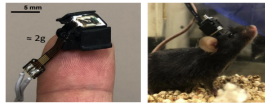


Local excitation and imaging of the brain



- L. Tabourin, F. Bretzner and T. Galstian, *Towards a mini-endoscope design with spatially selective excitation and imaging*, Vol. 15, No. 3 / 1 Mar 2024 /Biomedical Optics Express, p. 1750.

Combined (behavioral) imaging

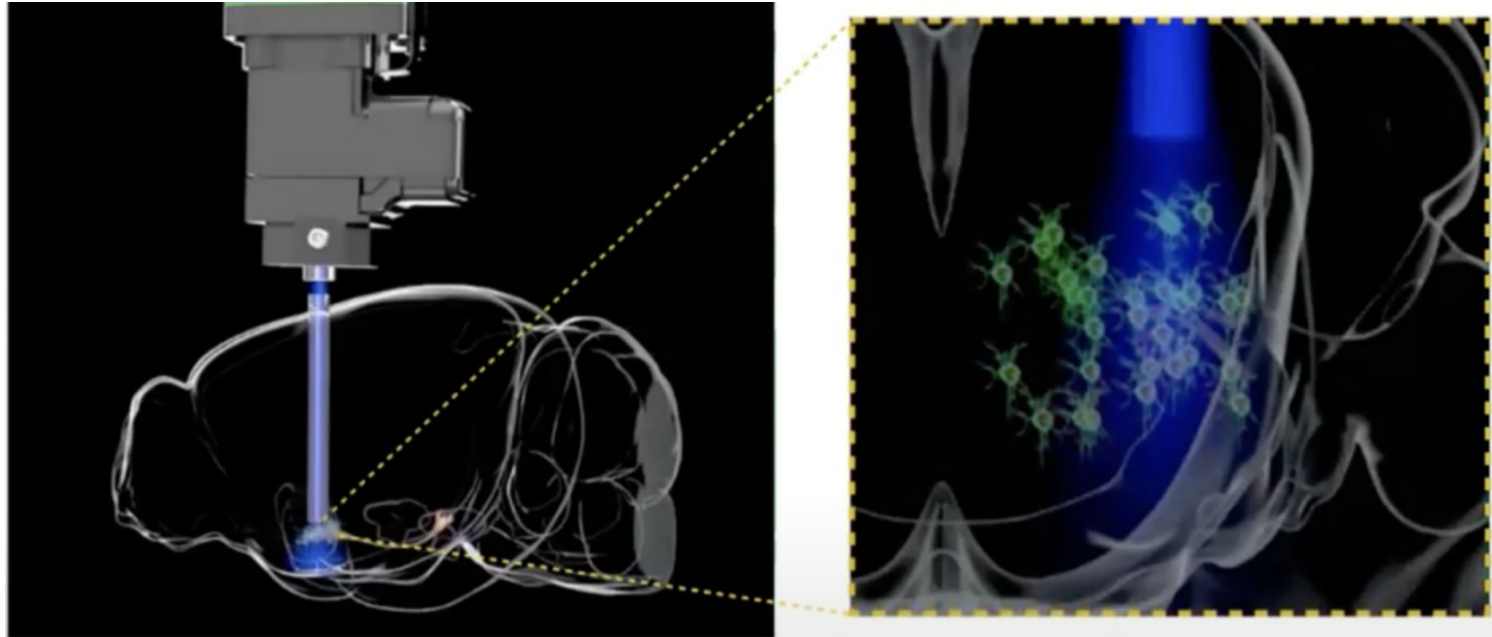


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The surgery

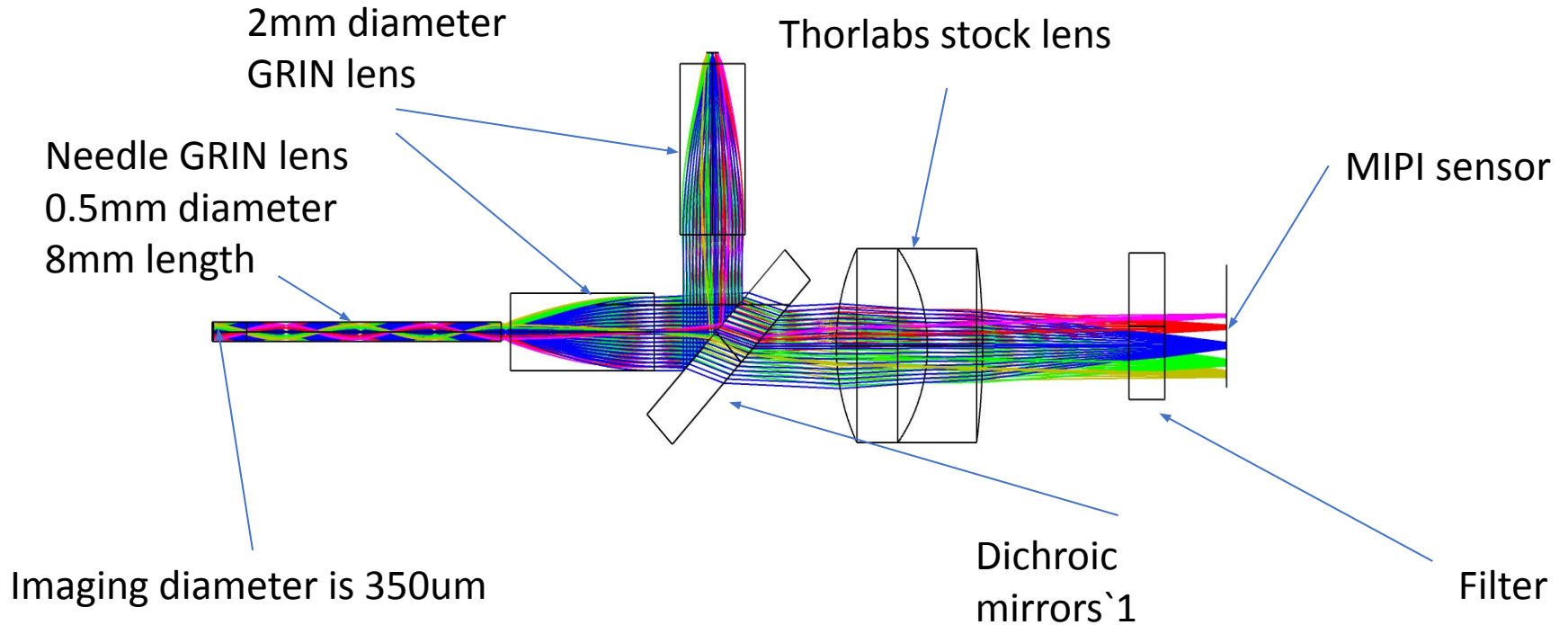


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Lens Design



Housing assembly testing



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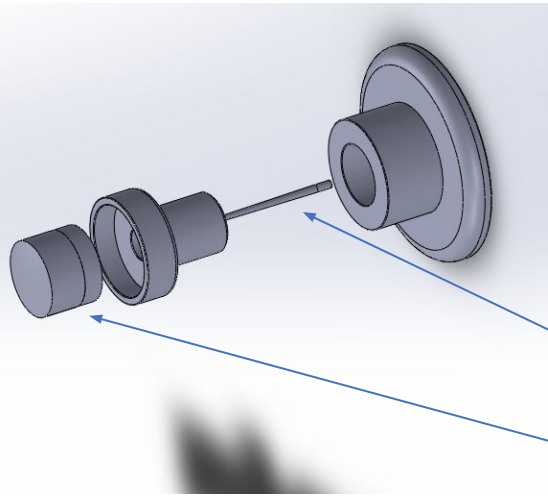


Housing assembly

Light source place

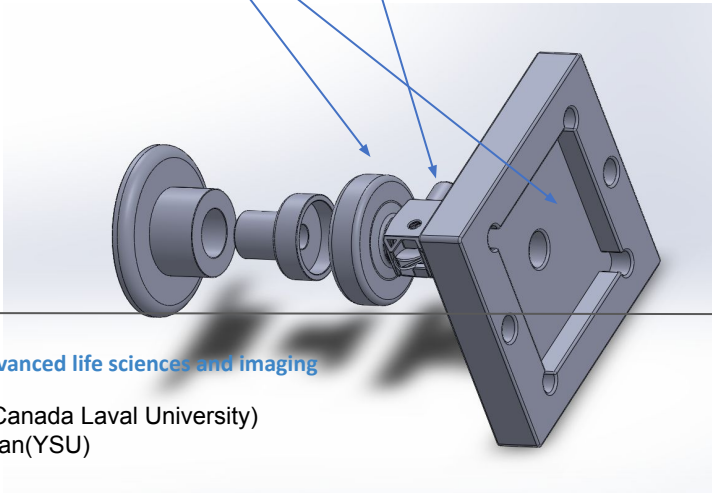
Main housing

Mipi sensor place



GRIN lens

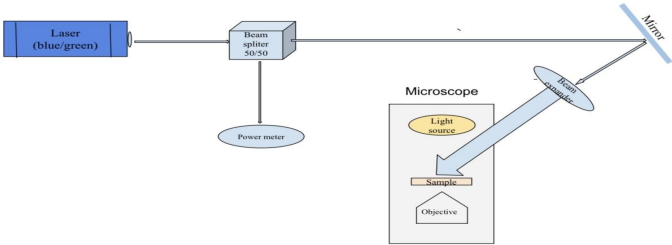
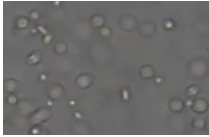
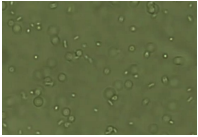
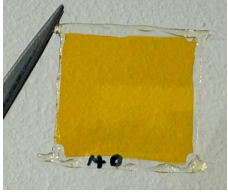
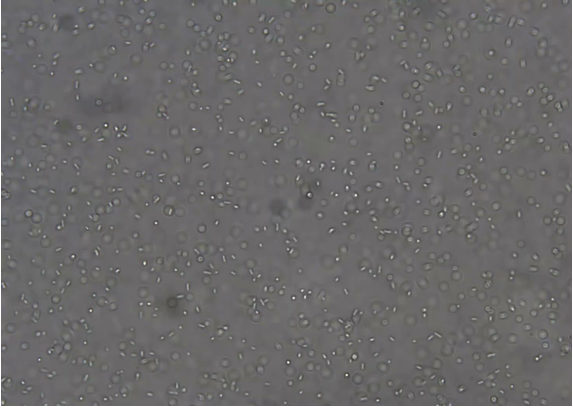
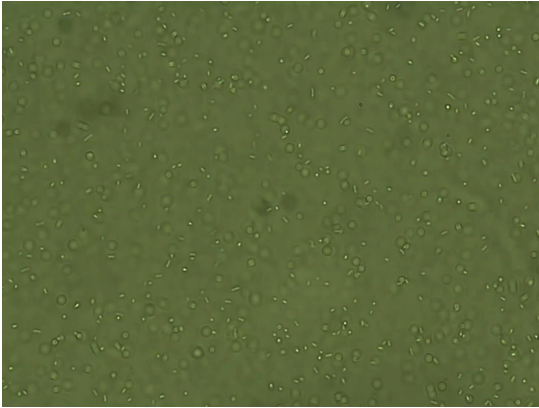
Doublet



Whole length is less than 25mm
Housing weight is about 1.1g
Lenses and filter is about 0.5g



Photodynamic control of bacterial



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Grants

1. RA MoESCS Higher Education and Science Committee equipment grant

Conference participants

1. Armenian-German WE-Heraeus Seminar
"Optics and its Applications in Quantum Technologies"(Armenia, Yerevan)
2. LC international Conference(Canada, Quebec)

THANK YOU FOR YOUR ATTENTION

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