

Social background and issues

- Biological membrane (plasma and intracellular membranes) perform a wide range of essential functions, such as signal transduction, and energy conversion.
- Membrane functions are crucial for drug discovery, diagnostics, food and environmental inspections.
- Understanding the physicochemical properties and functions of the biological membranes is challenging.

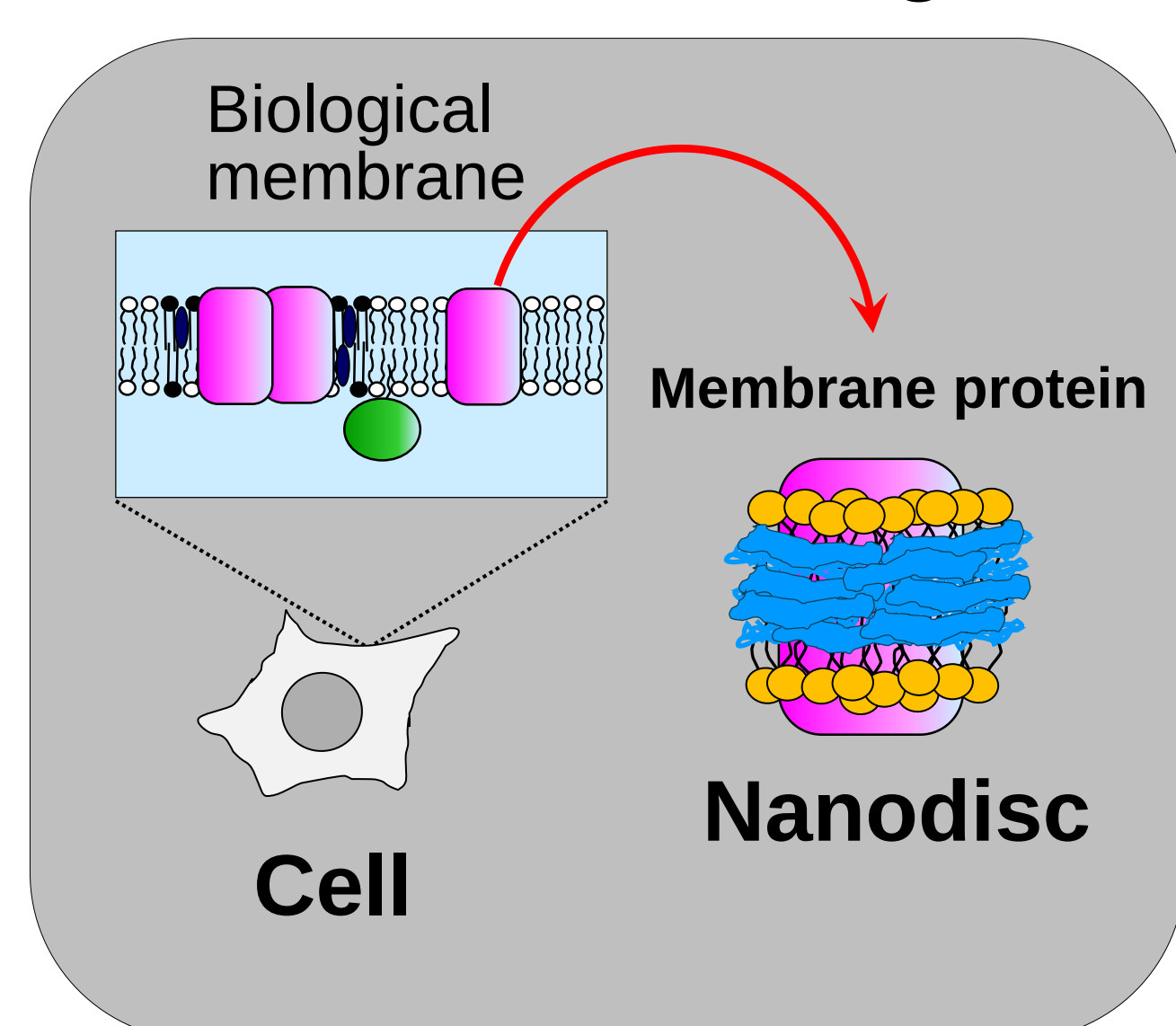
Current state of the technologies

- Cell or cell-derived membranes are mainly used.
- Model membranes (e.g. nanodiscs) and *in-silico* approaches are also being applied.
- These approaches cannot provide detailed information on the membrane functions at the molecular level.

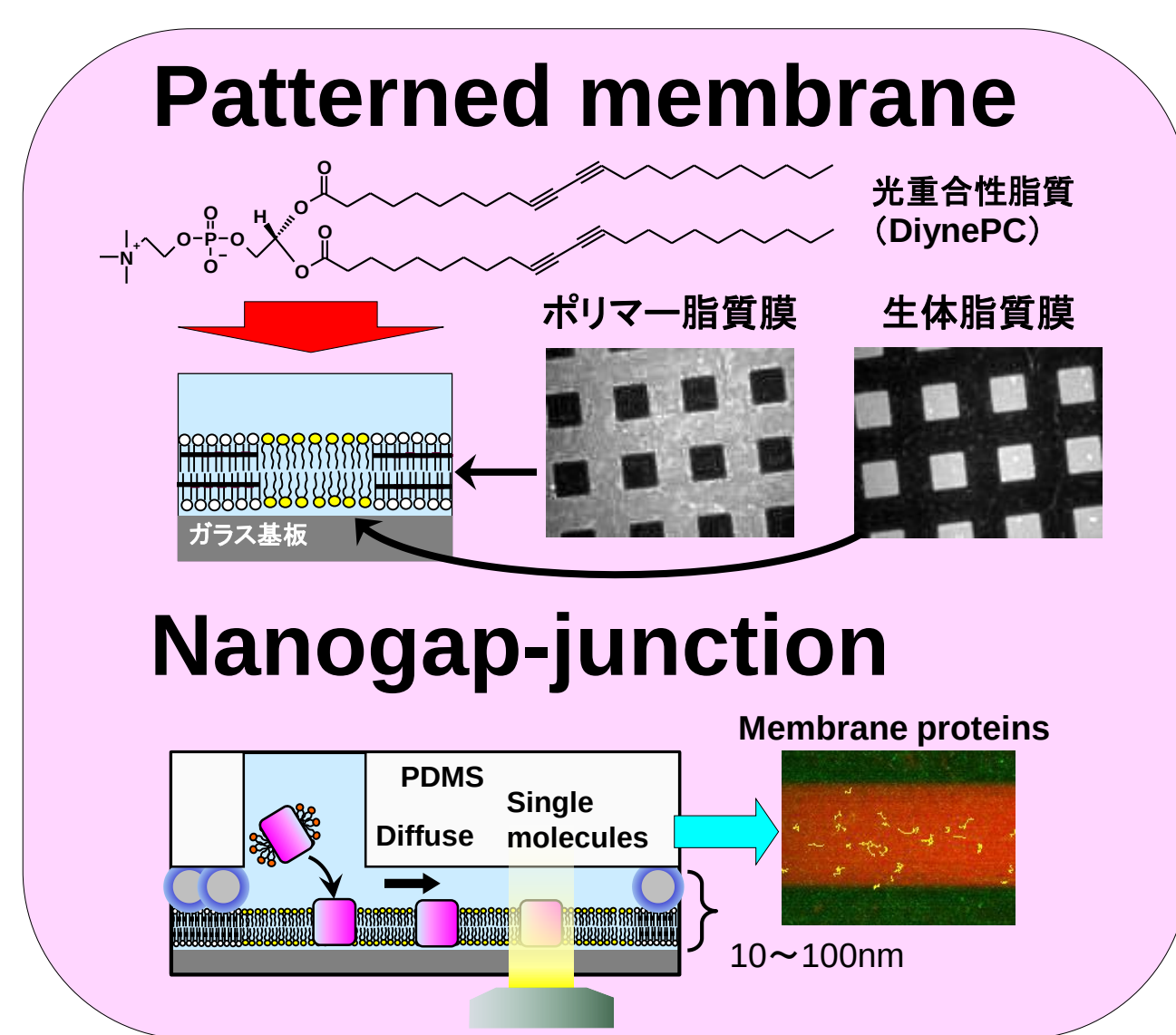
Technical Significance

1. Objectives

Current technologies



Developed technology

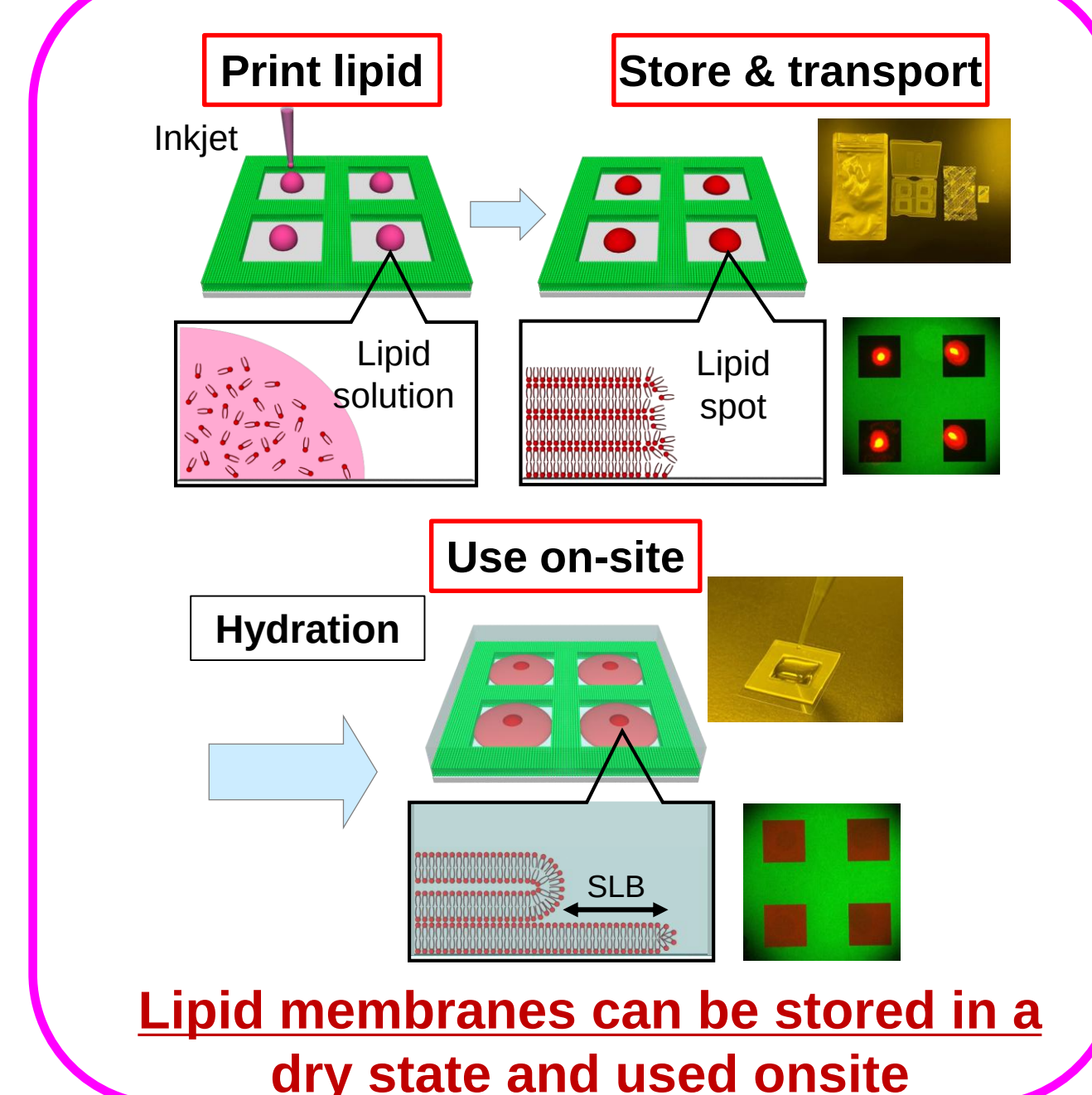


Significance

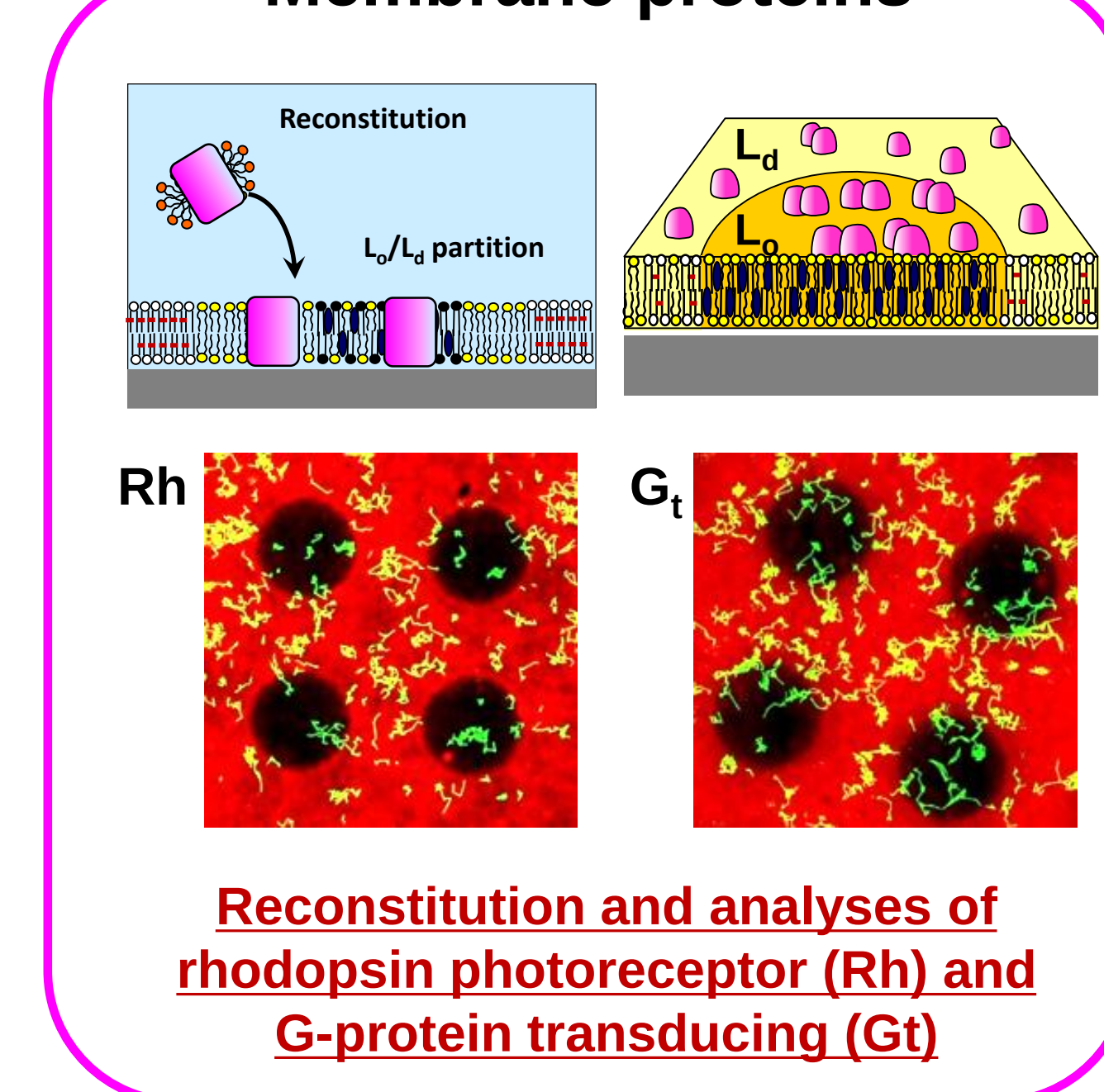
- Fluid biological membranes embedded and stabilized in a polymeric lipid bilayer framework.
- Lipid compositions, membrane protein density, and oligomeric state can be controlled.
- Functional reconstitution and quantitative analysis of membrane proteins.
- Highly sensitive, single-molecule detection of membrane-bound molecules using nanometric confinement.

2. Results

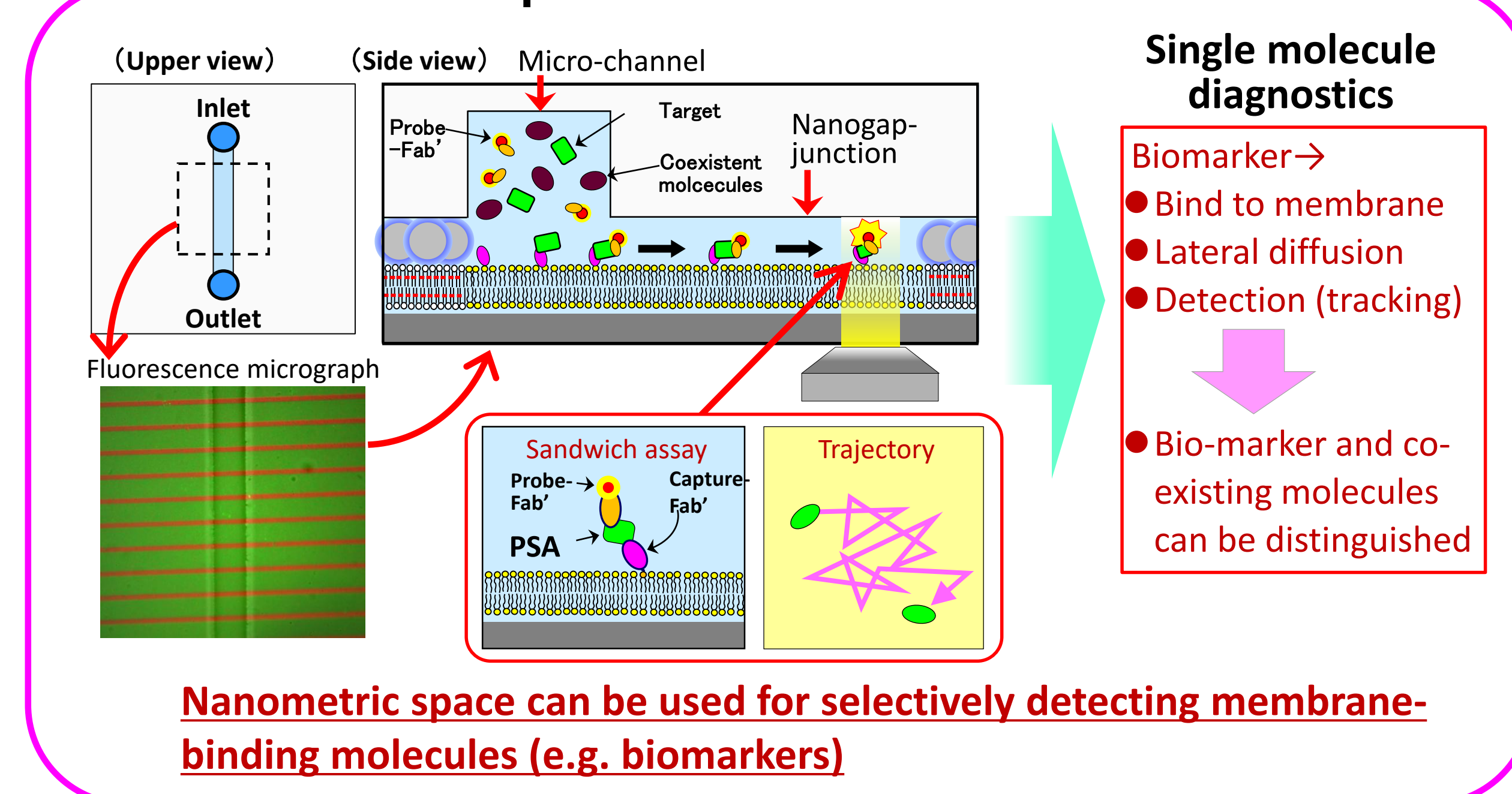
Print & store the membrane



Membrane proteins



Nanometric space for detection of biomolecules

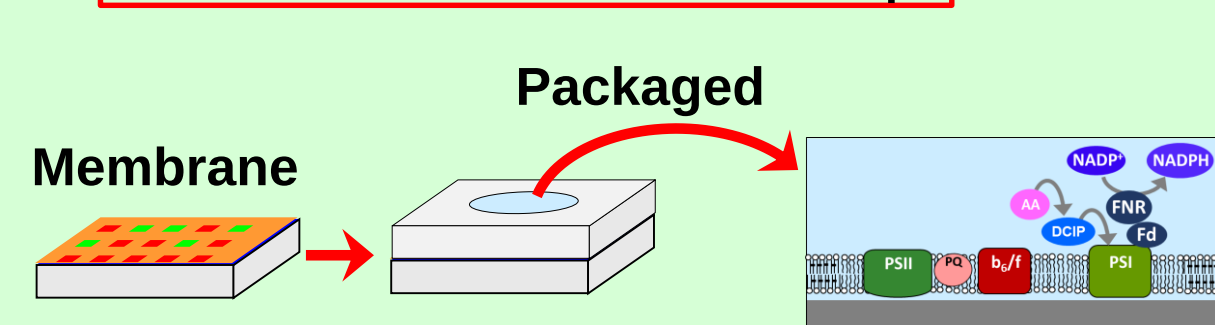


Future Prospective

Envisioned applications

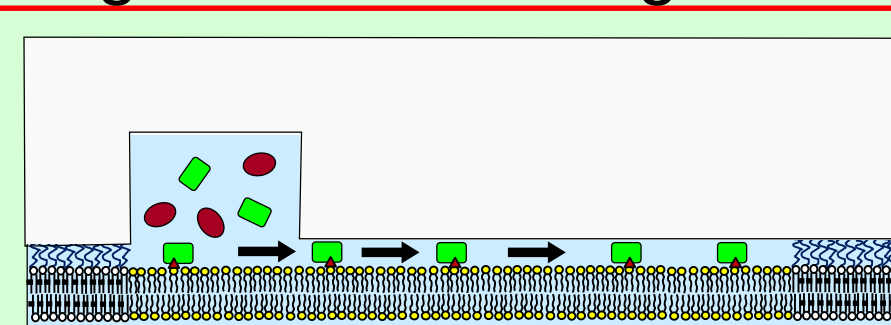
Application 1

Artificial membrane chip



Application 2

Single molecule diagnostics



- ✓ Detection of biomarkers (single molecule diagnostics)
- ✓ Drug development and analysis of membrane proteins
- ✓ Basic research on the biological membrane

We seek collaboration in the following areas

- Diagnostics & Bioreagents
- Pharmaceuticals & Drug Discovery
- Semiconductor & Microfabrication
- Optics, Analytics & Software

Publications and patents

Publications: 45 original papers and 22 reviews in international journals

Patents:

- Functional substrate using polymeric lipid bilayer, JP patent-5532229 (2014)
- Nanogap-junction-based biochip, JP patent-6400483 (2018)
- Artificial biomembrane containing membrane proteins, JP patent pending 2021-173293 (2021)
- Analysis of membrane-binding molecules in exosomes, JP patent-7912715 (2026)
- Detection of biomarkers in the nanogap-junction, JP patent pending 2025-185236 (2025)

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