

Nucleus Developer Notes

Biochromatic Materials

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Abstract

This is a system-level plan for developing Biochromatic Materials, a modular integration of Developer Cells into materials for color-based reporting.

Keywords Developer Cells, Demonstration

Published Feb 01, 2025

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1. OVERVIEW

Our integrated demonstration combines artificial cells containing genetically encoded sensors with hydrogel materials to create a functional, responsive material system. When exposed to specific ligands, such as theophylline or anhydrotetracycline (aTc), the artificial cells produce distinct colorimetric outputs, providing a visible signal of ligand detection. By using 3D printing to structure the hydrogel, these colorimetric responses can be spatially organized and made machine-readable through QR codes, enabling digital detection of one or both target molecules in a single platform. This approach allows for real-time monitoring of molecular signals while maintaining the stability and function of the encapsulated artificial cells within the material. In the broader context of synthetic cell engineering, this system demonstrates a transition from isolated “developer cells” toward more integrated, material-embedded synthetic cell films, or syncell-based films. By bridging molecular sensing and structured material design, our demo advances the practical capabilities of synthetic cell technologies and moves along the arc of the whitespace chart toward scalable, functional synthetic cell applications.

2. COMPONENT MODULES

- **Module 1-1:** Plans for in vitro validation of the sensors going into the Chicago node demonstration. [\[link\]](#)
- **Module 1-2:** Environmentally Responsive Materials via Integration of DevCells. [\[link\]](#)
- **Module 1-3:** Matrix Design for Stable Liposomes and Efficient Cell-Free Protein Synthesis. [\[link\]](#)
- **Module 1-4:** In Vitro Reporter Validation. [\[link\]](#)
- **Module 1-5:** Module Development Plan: pH sensor. [\[link\]](#)
- **Module 2:** Colorimetric Sensing Module Development Plan. [\[link\]](#)
- **Module 3:** Photopatterned Hydrogels with DevCells. [\[link\]](#)

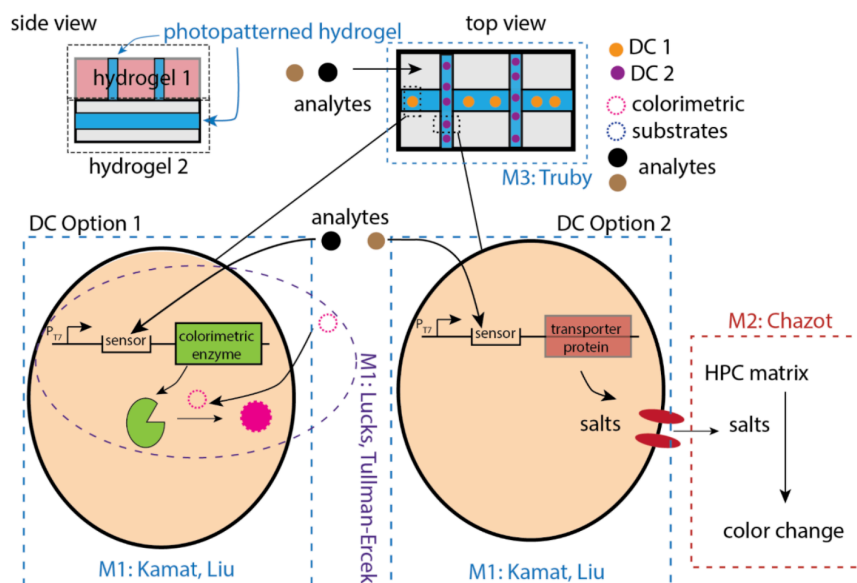


Figure 1. Modules and integration diagram for the proposed demonstration.