Research Poster

Artificial Cells with Liquid-liquid Phase Separation-Regulated Cell-free Protein Synthesis

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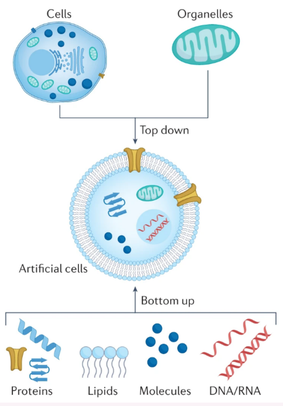
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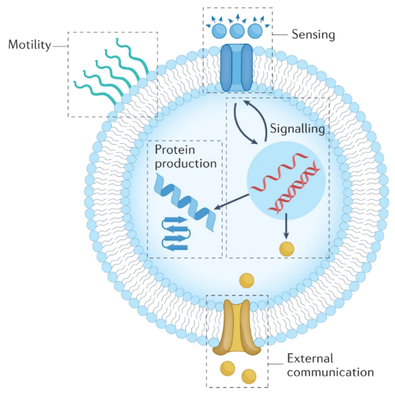
HIGHLIGHTS

Artificial Cells | CFPS | LLPS Regulation | Microfluidics

Introduction

Cell-free protein synthesis (CFPS) has rapidly emerged as a versatile platform for producing functional peptides. CFPS enables tightly controlled microenvironments that support complex enzyme cascades, molecular assembly and even programmable biosensing. **Liquid–liquid phase separation (LLPS)** describes the demixing of biomolecules. LLPS can generate protein aggregates that impair protein function. Thus, harnessing the phase behavior to modulate protein functionality constitutes a compelling frontier.

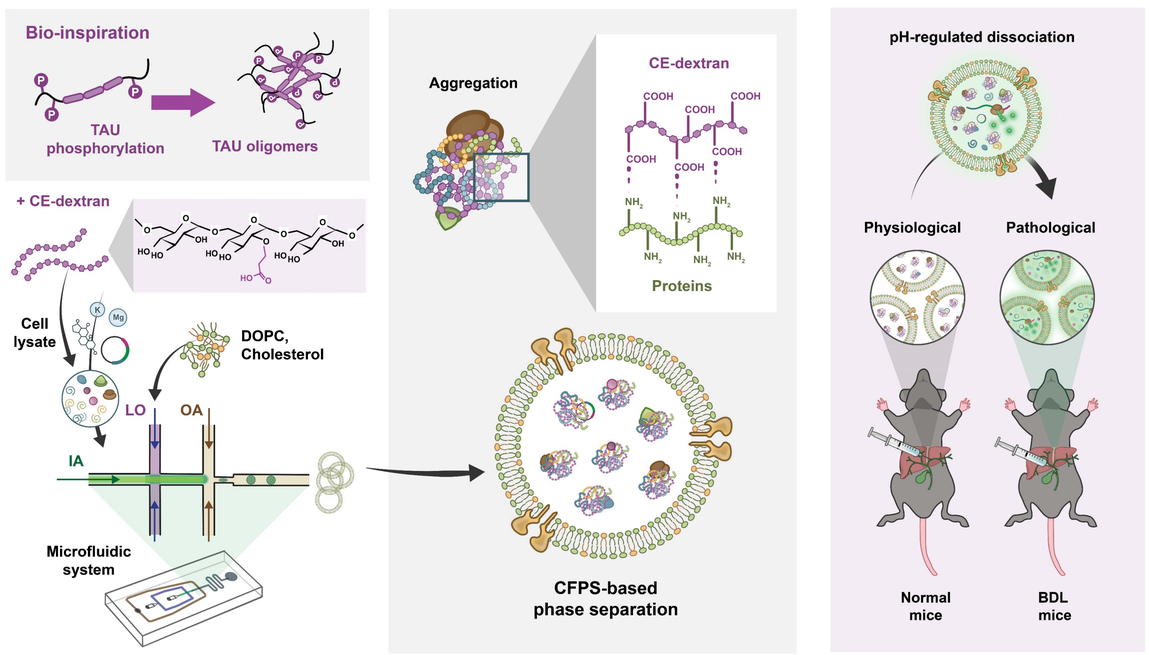




Objectives

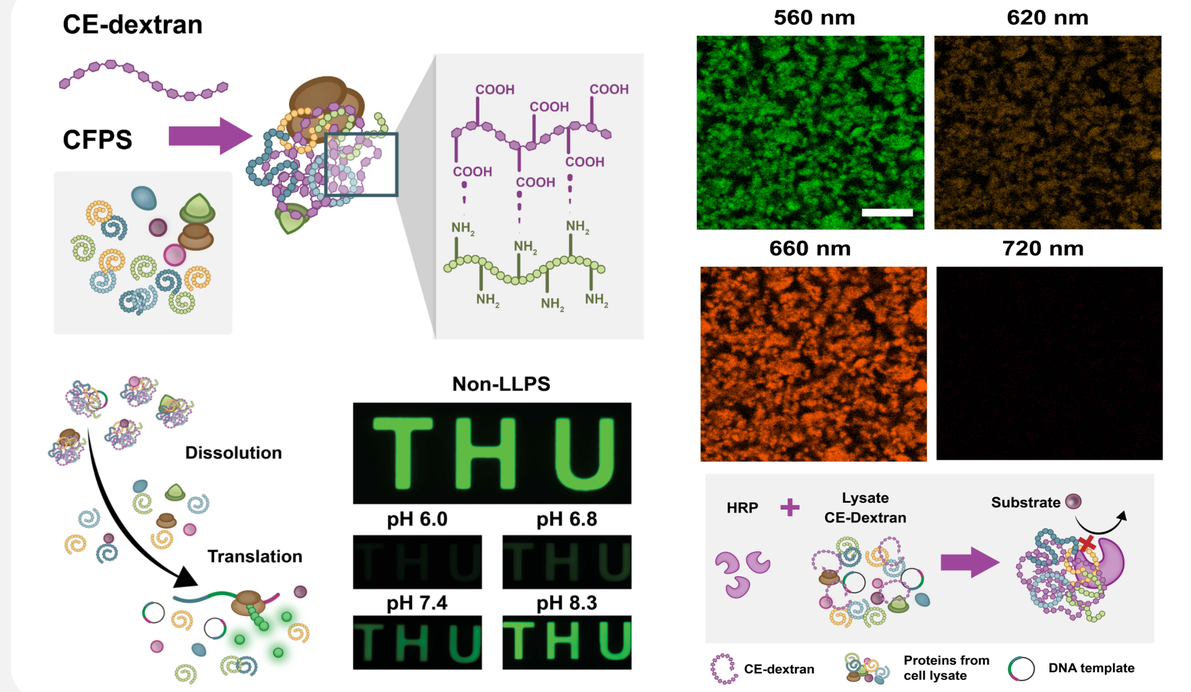
- Developing a synthetic polymer that undergoes reversible LLPS to aggregates and entrain CFPS, enabling on-demand control.
- Establishing a microfluidic chip to generate liposome, co-encapsulating CFPS to create tunable artificial cells.
- Demonstrating disease-responsive sensor-actuator function of LLPS-regulated artificial cells in vivo.

Methods

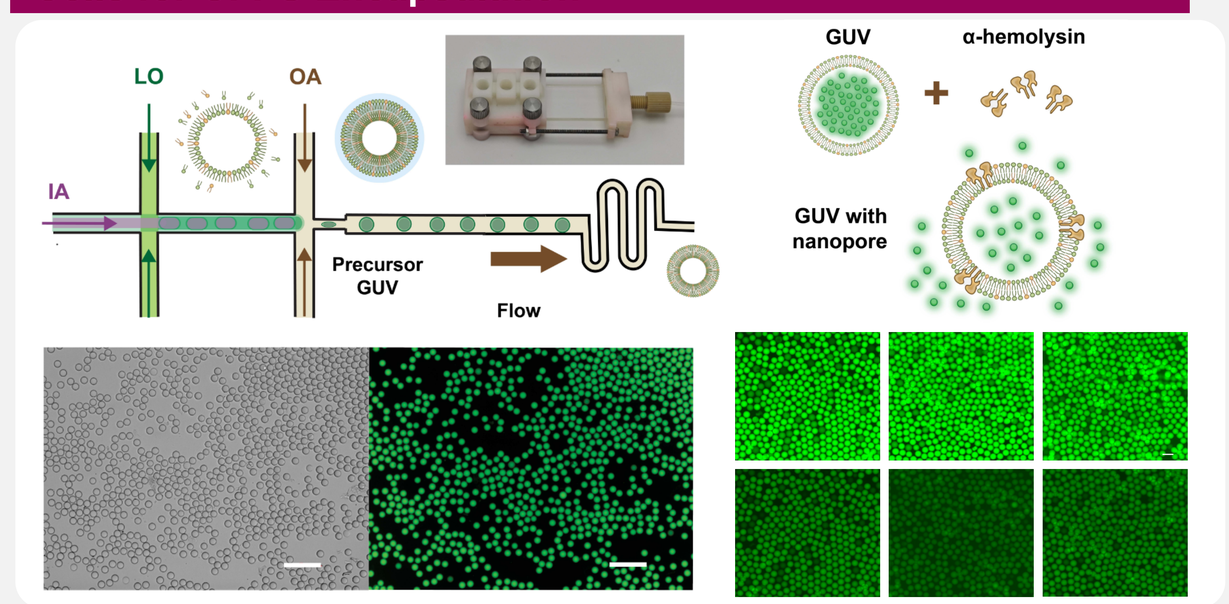


Results

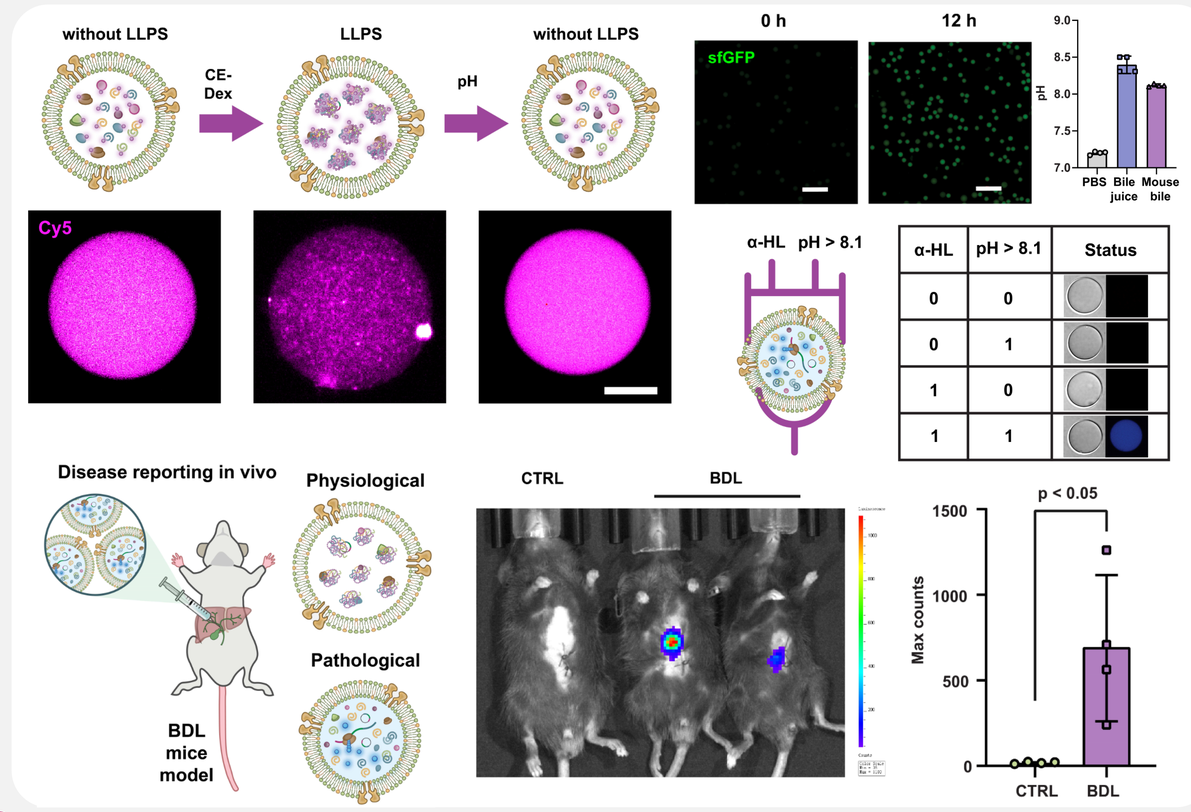
1. Reversible Aggregations and Dissociation of CFPS and Recovery of Protein Expression



2. Microfluidic Assembly of Nanopore-Integrated Artificial Cells for CFPS Encapsulation



3. Controlled Protein Expression of Artificial Cells in Vivo



Conclusion

- CE-Dex-induced LLPS enables control of protein expression via reversible aggregations formation.
- Artificial cells with LLPS-regulated CFPS exhibit dynamic, environment-responsive behavior.
- LLPS-regulated artificial cells achieve spatially resolved, disease-state-dependent protein expression.

Reference: Nat Rev Chem 6, 562–578 (2022). Nature 609, 1029–1037 (2022)

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