

Stimulus-responsive coacervate for payload release

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Biomolecular condensates form from liquid-liquid phase separation provide distinct internal environments that can selectively organize molecules and reactions. Many studies have shown that condensates can also contain multiple coexisting liquid phases, creating an opportunity to spatially separate different chemical functions within the same droplet. However, how such internal organization can be used to control a stimulus-responsive molecular release remains less explored.

In an ongoing work, we have developed a nested multiphasic condensate system formed from LVFFAK₉, R₉, and polyacrylic acid (PAA), in which LVFFAK₉- and R₉-rich phases coexist within the same condensate. In the present study, we adapt this system to investigate whether reactive oxygen species generated in one phase can trigger molecular release from another. R₉ is functionalized with fluorescein isothiocyanate (FITC) through the redox-responsive sequence GPPG to form R₉GPPGFITC, while the aggregation-induced emission photosensitizer PS-1 is incorporated into the LVFFAK₉-rich phase.

Upon light irradiation, PS-1 generates ROS, which are expected to diffuse across the internal phase boundary and cleave the GPPG linker, resulting in release of the FITC-containing fragment from the condensate. Fluorescence imaging and UV-visible spectroscopy will be used to follow the spatial distribution of the fluorescent components and evaluate ROS-induced FITC release.

Overall, this work aims to establish a proof of concept for using multiphasic condensates as spatially organized, light-responsive systems in which a reaction initiated in one phase can trigger cargo release from another.

Schematics of the original LVFFAK₉, R₉, PAA multiphase condensate

