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FROM DYNAMIC STRUCTURES TO FUNCTIONAL MATERIALS

Biomimetic Peptide Coacervates: Towards Functional Artificial Organelles

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The **Biocondensates Group** investigates the design and function of **short peptide-based coacervates** as minimalistic yet powerful models for biomolecular condensation and intracellular organization. Our research focuses on understanding and harnessing **liquid–liquid phase separation (LLPS)** to create dynamic, tunable systems with programmable properties. We study how sequence-defined short peptides spontaneously assemble into **coacervate droplets**, how these assemblies undergo **stimuli-responsive phase transitions**—for example, switching between soluble, coacervate, and fibrous states in response to pH—and how these transitions can be controlled at the molecular level.
A key aspect of our work is the **covalent integration of functional chemical groups** (e.g., photocatalytic or redox-active moieties) to impart **intrinsic reactivity and responsiveness** to peptide condensates. Furthermore, we explore strategies for **organelle-specific targeting** using functionalized peptide coacervates as **drug-delivery vehicles** capable of selective localization and controlled release. Together, these efforts aim to advance the fundamental understanding and technological potential of peptide-based biomolecular condensates.