Engineered protein scaffolds to study the formation of membrane-less organelles in mammalian cells

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Membrane-less organelles, containing both proteins and nucleic acids, are ubiquitous in cells and contribute to numerous important biological functions, including the storage and processing of mRNA and other biomolecules. Recently, novel multidisciplinary approaches have emerged providing paradigm-shifting advances about the origin of the biophysical properties of diverse membrane-less organelles. Indeed, the concept of phase transition in the cytoplasm has been proposed to describe the formation and dynamics of ribonucleoprotein granules throughout the cell cycle and development. Besides several age-related neurodegenerative diseases seem to be linked to aberrant phase transitions controlling organelle formation. However, how these supramolecular structures precisely assemble and disassemble in the cell, and how their function is spatially and temporally controlled remain questions unanswered by classical cell biology approaches. We proposed a novel strategy based on engineered protein scaffolds that assemble into micrometer-sized structures to reproduce the membrane-less organelle formation into the cytoplasm of mammalian cells. Such approach is an interesting tool to quantitatively assess the impact of biophysical parameters on the self-assembly process, but also how the condensation of biomolecules by phase separation can regulate functions in the cell.