Monitor and modulate the phase behaviour of biomolecular condensate by using microfluidic and optical techniques

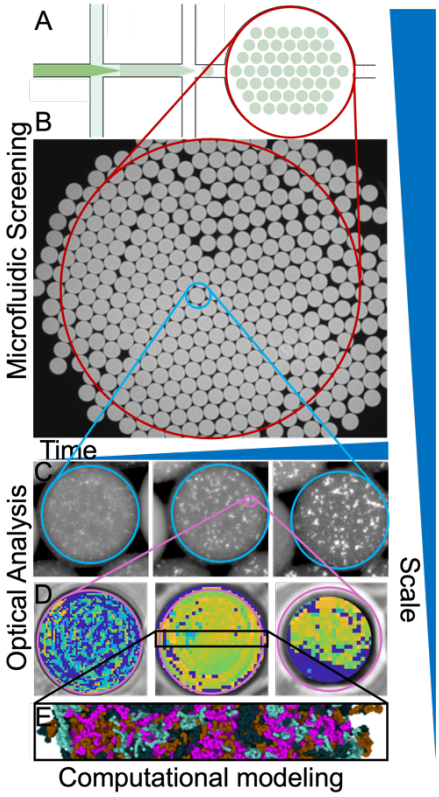
Shen, Yi[1]; Vigolo, Daniele[1]; Ilhamsyah, Dea[1]; P. J. Knowles, Tuomas[2]; Weitz, David[3]

1. Engineering, school of Chemical and Biomolecular Engineering, University of Sydney, Sydney, NSW, Australia.

2. Chemistry, The University of Cambodia, Cambridge, United Kingdom.

3. Harvard University, Cambridge, MA, United States.

Many large molecules in cells can separate into different phases, creating special structures called biomolecular condensates. These condensates are essential for various biological processes, but sometimes they can turn from a liquid-like state to a solid-like state, which is linked to the development of neurodegenerative diseases. However, we don't fully understand how this transition happens in healthy condensates. In our research, we used microfluidic and optical techniques to study this transition(*1*, *2*). We found that in the case of a specific molecule called FUS, the condensate doesn't uniformly become solid. Instead, it contains both liquid and solid parts at the same time, making it uneven in structure(*3*, *4*). Crucially, this change begins at the edge of the condensate and moves inward. The addition of nucleic acids alters the phase behaviour as well. We introduced a new method, Spatial Dynamic Mapping Microscopy, to track and measure this transition's local dynamics. Our findings show that this transition starts at the boundary between the dense and less dense parts of the condensate. This highlights the importance of where and when this transition occurs, shedding light on how it might contribute to the formation of harmful protein clumps in diseases.



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