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Liquid-Liquid-phase separation studied by Holo-tomography

Upon heating, egg yolk transforms from a liquid to a grainy gel due to a combination of lipid aggregation, protein denaturation-aggregation-gelation and other processes. Understanding the structural dynamics of the egg yolk transformation provides crucial insights into protein transformations with wide-ranging implications for medicine and industry. Protein denaturation and aggregation are related to important processes in food industry and also to several neurodegenerative diseases. The heat-induced transformation of egg yolk can serve as a useful model to gain a better understanding of these processes. To investigate these complex transformations, we turned to advanced imaging techniques that overcome traditional limitations. Coventional imaging techniques such as electron microscopy typically require sample fixation or drying, which potentially limit the resolution and sample fidelity. Using X-ray holographic tomography, which uses X-ray phase contrast to generate three-dimensional images of soft tissues without destructive sample preparation, allowed us to investigate structural changes in egg yolk during boiling in its native state. Our results reveal a developing separation between proteins and lipids, with fatty components rapidly aggregating into large globules that further evolve into bubbles, highlighting the requirement for fast in-situ measurements to capture dynamic changes across length-scales ranging from sub-micrometer to hundreds of micrometers.

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