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From Phase Separation to Vaccine Design: Small-Angle Scattering in Biomolecular Research

Neutron scattering is a powerful characterization technique for investigating the structure and dynamics of biomacromolecules, as well as their interactions. In particular, small-angle neutron scattering (SANS) enables the characterization of structural features across a wide range of length scales, from just a few nanometers to several hundred nanometers. Additionally, SANS offers unique advantages through contrast matching, allowing for the selective characterization of individual components within complex structures and providing insights into the hydration states of the measured materials. Our research utilizes neutron scattering to investigate biomacromolecular interactions with the primary objective of gaining a deeper understanding of their biological functions and material properties. Our research extends in two major directions: (1) understanding the phase behavior of biomacromolecular complexes in various crowded environments, as recent studies highlight the importance of liquid-liquid phase separation (LLPS) in underpinning fundamental biological processes, and (2) elucidating the mechanism of action of aluminum adjuvants in vaccine formulations. By employing SANS, we have probed the hydration and porosity of aluminum adjuvants, providing critical insights into their microstructures. These studies yield critical insights into the microstructures of aluminum adjuvants and offer new perspectives on their functional mechanisms. Together, these studies highlight the power of neutron scattering in providing fundamental, molecular-level insights into biomacromolecular interactions—knowledge that can inform both basic biological research and the rational design of functional materials across diverse fields.

Topical Area

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