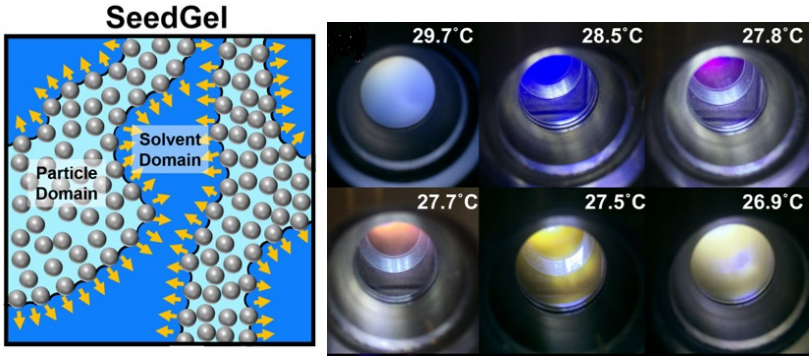
# Studying the gelation mechanism of a colloidal gel in a binary solvent using USANS

NIST Center for Neutron Research
USANS Experiment




## Abstract

The Ultra Small-Angle Neutron scattering (USANS) instrument at the NCNR is based on a Bonse-Hart design and can probe the structure with the length scale from about a few hundreds of nanometers to about twenty micrometers. It has been used to study a wide range of materials, such as shale, paints, and polymers. During this neutron school experiment, USANS will be used to study the structures of a new type of colloidal gels in binary solvents, the solvent segregation driven gel (SeedGel). When dispersing colloidal particles in a binary solvent, the microscopic phase separation of a binary solvent can lead to the formation of a SeedGel if the surface of particles preferentially favored by one component of a binary solvent. In a SeedGel, the binary solvent has a phase transition into two domains with different solvent compositions and colloidal particles are all preferentially jammed in one solvent phase to form a particle domain and solvent domain. [1,2] SeedGel is thermos-reversible and scalable with very precise structure reproducibility during the temperature cycling. And some SeedGel systems show interesting dynamic coloration properties with temperature controlled color change that can be finely adjusted over the entire visible spectrum [3] with interesting optical applications, such as smart windows and temperature sensors. Using the USANS instrument, we can investigate the domain size and understand how the temperature quenching rate determins the domain size. Various aspects of the experiment from the sample preparation and USANS instrument setup to data treatment and interpretation will be investigated, and references are given for more in-depth study. Even though the experiment focuses on the USANS instrument and their data analysis, we will also discuss how to analyze the SANS data of SeedGel to learn the local structural information of particles in the particle domain.

[1]Y. Xi, R. S. Lankone, L.P. Sung, Y. Liu, *Nature Communications*, 12, 910 (2021).
[2]Y. Xi R. Murphy, Z. Zhang, A. Zemborian, S. Narayana, J. Chae, S. Choi, A. Fluerasu, L. Wiegart, Y. Liu, *Soft Matter*, 19, 233 (2023).
[3]Y. Xi, F. Zhang, Y. Ma, V. M. Prabhu, Y. Liu et al., *Nature Communications*, 13, 3619 (2022).