Phase behavior of Laponite dispersion and universality of the scaling relations during sol-gel transition

Prof. Yogesh M. Joshi
Department of Chemical Engineering
Indian Institute of Technology Kanpur, India.

We discuss the use of rheological tools to study the phase behavior of aqueous suspension of charged discotic clay particles of LAPONITE®, a highly contested system in the literature. While scattering studies suggest a transition from attractive gel (<2 wt%) to repulsive Wigner glass (>2 wt%), our time-resolved rheometry over 1–4 wt% reveals linear viscoelastic signatures of a sol-gel transition typical of crosslinking polymers, indicating a critical gel state with a percolated network, confirmed by cryo-TEM images. This contradicts scattering results and supports an attractive gel across the studied range. We also discuss rheological distinctions between gels and glasses and the source of discrepancy with scattering. In the second part, we show how Laponite obeys scaling and hyperscaling laws near the critical gel state, marked by power-law divergence of zero-shear viscosity, low-frequency modulus, and longest relaxation time, reinforcing its gel-like microstructure.

Speaker bio : Dr. Yogesh Joshi earned his B.E. from Pune University in 1996 and his Ph.D. in Chemical Engineering from the National Chemical Laboratory Pune and the IIT Bombay in 2001. He then joined the Benjamin Levich Institute in New York for post-doctoral studies. In 2004, Dr. Joshi joined the Department of Chemical Engineering at the Indian Institute of Technology Kanpur, where he is currently the Sir J C Bose Fellow and Mr. and Mrs. Gian Singh Bindra Chair Professor. His research interests include the rheology of complex fluids, soft matter, interfacial science and engineering, clay dispersions, and polymer science and engineering. He is a senior editor of *Langmuir* and serves on the editorial advisory boards of Physics of Fluids, Journal of Rheology, and Rheologica Acta. He is an elected fellow of the Society of Rheology (US), the INSA, INAE and NASI, India. He is also closely associated with many industries, helping to improve the flow behavior and stability of soft materials. More information is available on his group website: http://home.iitk.ac.in/~joshi/