Cryogenic transmission electron microscopy and small-angle X-ray scattering: the structure of colloidal gels revisited

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We discuss recent studies of colloidal thermosensitive core-shell particles by cryo-transmission electron microscopy (cryo-TEM). The particles consist of a solid core of poly(styrene), onto which a network of crosslinked poly(N-isopropylacrylamide) (PNIPAM) is affixed. In water the shell of these particles swells when the temperature is low. Raising the temperature above 32°C leads a marked shrinking of the shell. Recently, we presented the first study of these core-shell particles by cryo-TEM in situ, that is, in aqueous solution [1]. We demonstrated that the core-shell particles are well-defined and exhibit a narrow size distribution. In particular, the PNIPAM-shell is compact and has a defined outer surface of a slightly irregular shape. Moreover, the micrographs show that there are density fluctuations within the network. Cryo-TEM of the system above and below the transition temperature furnishes information about the thermosensitive particles that had not been available through other methods employed in previous investigations [2]. Moreover, we discuss a novel method by which the electron densities of the particles can be read out from the images and compare these data to measurements done by small-angle X-ray scattering (SAXS). In this way we can compare the results of cryo-TEM studies to SAXS-studies done on the same particles.

[1] Alexander Wittemann, Markus Drechsler, Yeshayahu Talmon, Matthias Ballauff, *High Elongation of Polyelectrolyte Chains in the Osmotic Limit of Spherical Polyelectrolyte Brushes: A Study by Cryogenic Transmission Electron Microscopy*, J. Am. Chem. Soc. 2005, **127**, 9688.

[2] J. J. Crassous, M. Ballauff, M. Drechsler, J. Schmidt, Y. Talmon, *Imaging the volume transition in thermosenstive core-shell particles by cryo-transmission electron microscopy*, *Langmuir* 2006, **22**,2403