Concentration and heating/cooling rate dependency of the phase transition and agglomeration process of poly(*N*-isopropylacrylamide) in concentrated microgel particle suspensions

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One of the most investigated smart polymers within recent decades is poly(*N*-isopropylacrylamide) (PNIPAM). PNIPAM chains and microgel particles exhibit reversible coil-to-globule and globule-to-coil transition processes induced by changing the temperature around the lower critical solution temperature (LCST). This thermo-responsive behavior has great potential for diverse application in biology, chemistry, and material science. For the optimal use of these materials the understanding of the transition process as well as the characterization and the adjustment of the LCST to a certain temperature is of high interest.

To get new insights into the transition and agglomeration process of thermo-responsive polymers, like PNIPAM microgel particles, in concentrated suspensions, inline process analytical technologies (PAT) are necessary. For typical analytical measurement techniques the monitoring of changes in highly concentrated and therefore often highly turbid dispersions is often difficult. The use of established and new selected PAT gives an access to monitor these dynamic changes during the transition and agglomeration process.

In this contribution, a combination of several PAT for the investigation of the concentration and heating/cooling rate dependence on the transition and agglomeration process of PNIPAM microgel particle suspensions is presented [1]. Photon Density Wave (PDW) spectroscopy and Particle Vision Microscope (PVM) measurements display an inverse hysteresis of the transition process with respect to temperature. The width of the hysteresis is directly correlated to the heating and cooling rates. Furthermore, a completely reversible agglomeration process is detected by PVM measurements and is Focused Beam Reflectance Measurement

(FBRM) and characterized in terms of its dependency on concentration and temperature.

[1] Werner, P., Münzberg, M., Hass, R., Reich, O.; Anal Bioanal Chem (2017) 409: 807. https://doi.org/10.1007/s00216-016-0050-7.