Superresolution Microscopy of thermosensitive Poly(N-isopropylacrylamide) microgel particles

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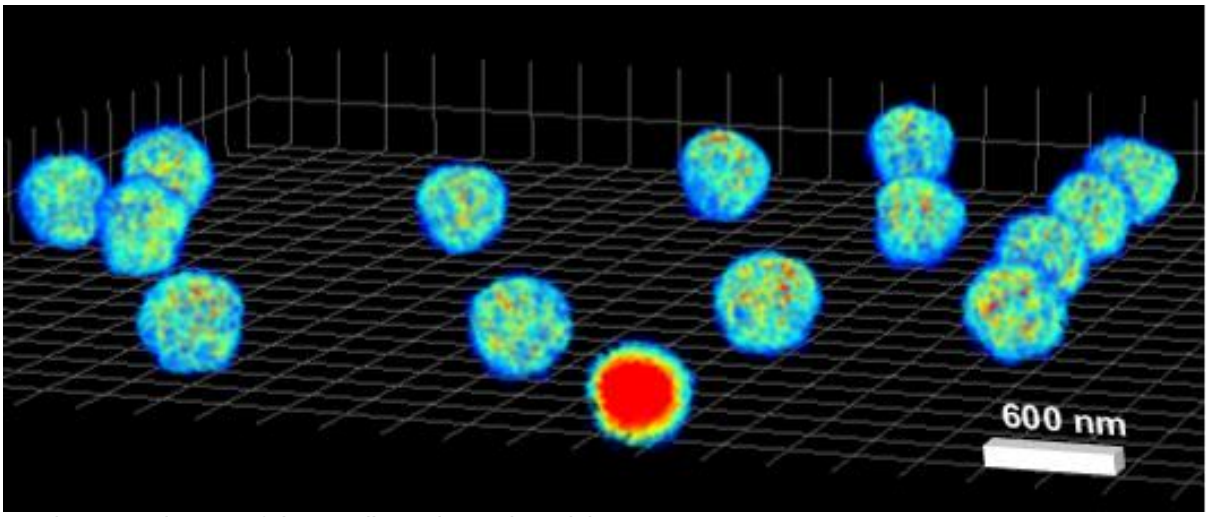
Hierarchical polymer structures such as pNIPAM microgels have been extensively studied for their ability to undergo significant structural and physical transformations that can be controlled by external stimuli such as temperature, pH or solvent composition. Despite this plethora of published work many fundamental questions remain unresolved. The mechanism that leads to the volume phase transition of PNiPAM microgels for example is not well understood and it's consequences towards the microgel architecture on nanoscopic length scales are unclear. It is still a puzzle, for example, that even in the collapsed state microgel particles contain a substantial amount of water. Moreover, the transition between swollen and collapsed microgels is less abrupt than expected for a phase transition and shows hysteresis. However, it is unclear to what extent these observations can be associated to individual particle properties or whether polydispersity in the ensemble of microgel particles is responsible. Scattering techniques are not well apt to answer any of these questions since they only provide access to ensemble averaged structural information in reciprocal space. Single particle observations in situ have so far been hindered by insufficient resolution, with optical microscopy, or contrast, with cryo-TEM. However, in recent years super resolution microscopy techniques have emerged that in principle can provide nanoscopic optical resolution.
Here we discuss in-situ superresolution microscopy of dye-labeled submicron sized PNiPAM microgels [1]. We use direct STochastic Optical Reconstruction Microscopy (dSTORM) to image single microgels at different stages of the volume phase transition with resolutions of 20-30 nm. Moreover, we reveal their faceted structure when highly compressed, a feature not directly visible using other techniques.

[1] G. Conley, S. Nöjd, M. Braibanti, P. Schurtenberger, and F. Scheffold, Colloids and Surfaces A **499**, 18-23 (2016)



3D dSTORM image of the swollen microgel particles.