Quantitative Networkdensity Distribution Measurements on Smart Thermoresponsive Colloids by Super-Resolution Optical Microscopy

Stephan Bergmann[1], Oliver Wrede[2], Viola Mönkemöller[1], Thomas Hellweg[2], and Thomas Huser[1]

[1]Biomolecular Photonics, Department of Physics
[2]Physical and Biophysical Chemistry, Department of Chemistry
University of Bielefeld
Universitätsstraße 25, 33615 Bielefeld, Germany
E-Mail: sbergmann@physik.uni-bielefeld.de

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Fluorescence microscopy is a widely used tool in cell biology to resolve subcellular structures and reveal dynamic processes, such as molecular transport in or between cells. In the last decade, several techniques were developed that have enabled us to overcome the optical diffraction limit and to resolve even finer spatial structures.
We demonstrate the application of optical nanoscopy to the field of materials and polymer science. In this work, smart thermoresponsive acrylamide-based colloidal particles (microgels) are investigated with single molecule localization microscopy (SMLM) techniques (e.g. dSTORM) (Figure 1) [1] to gain knowledge about the crosslinker distribution within the colloids and to study their thermoresponsive behavior. Therefore, single molecule localizations are used to calculate a localization density distribution. The particle size as well as the stimuli response (pH, temperature etc.) of the microgels can be tuned by the choice of synthetic conditions [2] and is therefore directly influenced by the crosslinker distribution in the microgel. Precise knowledge of the particle morphology is crucial for designing tailor-made microgels, which are promising candidates for various applications, such as drug delivery, nanoactuators, or smart surface coatings [3]. We expect that the capability to visualize the nanostructure of microgels in-situ will allow us to e.g. dynamically determine temperature-dependent changes of the network density in the structure of single microgels triggered by external stimuli.

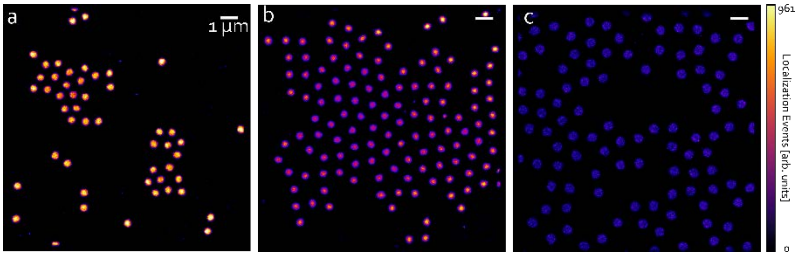

Figure 1 Reconstructed images of colloids made of NIPAM with different crosslinker proportions / mol% (a) 10.0, b) 7.5 and c) 5.0)

[1]. G.M.Conley et al., Colloids and Surfaces A: Physicochem.Eng.Aspects 499 (2016) 18–23
[2]. B. Wedel, Y. Hertle, O. Wrede, J. Bookhold, T. Hellweg, Polymers, 8 2016 162
[3]. K. Uhlig, T. Wegener, J. He, M. Zeiser, J. Bookhold, I. Dewald, N. Godino, M. Jaeger, T. Hellweg, A. Fery, C. Duschl, Biomarcromolecules, 17 (2016) 1110-1116