Dynamic Single Particle Probes of Temperature and Viscosity in Aqueous Media

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Luminescent nanocrystals are increasingly finding use as single particle probes because of their exceptional brightness and photostability, which enables imaging experiments to be conducted over extended periods of time compared to conventional fluorophores.[1] We will describe how conventional semiconductor nanocrystals can be further manipulated into novel heterostructures with extreme brightness, ideally suited for single particle experiments. We will also show how these unique heterostructures can be passivated with polymers for applications in aqueous media, which serve as a platform for further chemical modification or immobilization (e.g., to cell surfaces or nanofabricated substrates, channels, etc).

The sensitized emission from luminescent nanocrystals or heterostructures is largely insensitive to chemical and physical environment. Nevertheless, quantitative descriptions of these parameters at the nanoscale (i.e. with single particle resolution) would be an important advance from both and engineering and a biological perspective. We will describe how the surfaces of ultrabright nanocrystal heterostructures can be modified synthetically to produce hybrid materials that dynamically respond to either temperature or viscosity. Our nanothermometers and nanoviscometers are, to date, the most sensitive probes of these physical states at the nanoscale. We will further show how they are being implemented in a variety of single-particle bioanalytical schemes that bear relevance to discerning and discriminating spatiotemporal fluctuations in these states in live cells.[2]

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[1] L. A Bentolila, X. Michalet, S. Weiss, in *Single Molecules and Nanotechnology*, edited by R. Rigler and H. Vogel (Springer-Verlag, Heidelberg 2008).
[2] A. R. Bayles, H. S. Chahal, D. S. Chahal, C. P. Goldbeck, B. E. Cohen, and B. A. Helms Nano Lett. **10**, 4086 (2010).