Building an Imaging Toolbox: Nanosensors for Biological Discovery

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New tools have the potential to unlock unexpected insights into biology. We are extending the toolbox for cellular imaging by developing an array of optical nanosensors for the measurement of ion and small molecule concentrations in vitro and in vivo. Each sensor is based on a polymeric platform and works by extracting the analyte of interest into the particle, creating a change in optical signal. Our sensors are easily tuned for dynamic range and extendable to new analytes, such as sodium, histamine, glucose, and neurotransmitters. (1,2) In addition to creating novel probes, we are focused on the application of these nanosensors to solving biological problems. I will discuss our development of a “tattoo” for monitoring physiological analytes and pharmacokinetic profiles of drugs in vivo. In particular, our lithium-sensitive sensors can be injected into the dermal layer of the skin and monitored semi-continuously to obtain real-time drug concentrations. (3) In order to circumvent the limitations of fluorescence imaging in vivo, we converted our sensors to photoacoustics mode. We were able to achieve depth profile imaging, and monitor lithium dynamics in a murine model in real time. Ultimately, by combining advanced imaging techniques with our array of nanosensors, we plan to gain a better understanding chemical dynamics at a greater depth in vivo.

References