Metal Ion Responsive Sensing and Actuation in Live Cells via Delivery of Metal Ion-Specific DNAzyme-Nanoparticle Conjugates

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Research Goals:

• Design and use of novel DNAzyme and metal nanoparticles to detect and image the dynamics of metal ion distribution inside live cancer cells and correlate it with cell mechanical response.

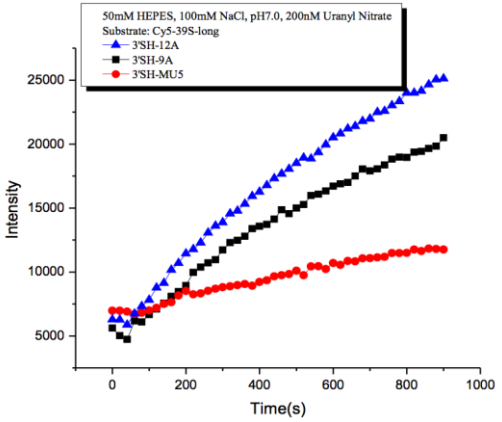
• Better understanding of cell mechanical properties as a function of disease state

Research Highlights and Results:

• Our group has used a rapidly screening technique called *in vitro* selection to select DNAzymes specific for a wide range of bioavailable metal ions and converted these DNAzymes into metal-ion specific sensors *in vitro* for environmental detection[1].

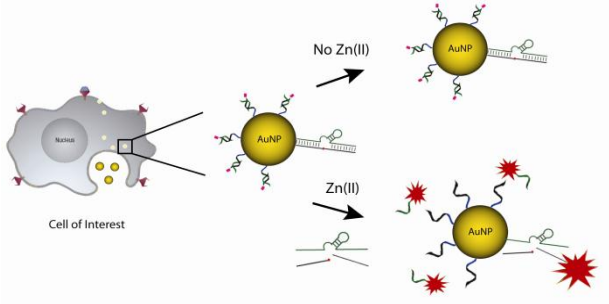
• As a proof of concept, to deliver DNAzymes into live cells, we have made uranium-specific DNAzyme-nanoparticle conjugates due to its extremely high selectivity over other bioavailable metal ions. We optimized the conjugates in order to give maximum turn-on fluorescence for imaging. Activity test shows that it has good stability and activity in buffer conditions similar to physiological conditions.

• As an alternative way, to further improve the stability of DNAzyme in cellular environment, we have also made caged zinc-specific DNAzyme whose activity can be specifically turned-on by UV light.



Future plans:

• Imaging and quantification of fluorescent signal upon delivery of the sensor into a cellular environment
• Study of the time-course of alterations in zinc homeostasis between normal prostate cells and prostate cancer cells
• Elucidation of the influence of zinc transportation on metastasis, including structure changes of cytoskeleton and cell membrane, changes in cell deformability and motility



[1]. Liu, J. W.; Cao, Z. H.; Lu, Y., Functional Nucleic Acid Sensors. *Chem Rev* **2009,** *109* (5), 1948-1998.