グローバル COE 物質科学イノベーション講演会

演 題：**Organics to metal clusters and back: Recovering weak fluorescence buried within high backgrounds**

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日 時：2009 年 8 月 27 日（木）13:00-14:30

場 所：理学部 7 号館・7-219/220 室

要 旨：Fluorescence imaging in biological and medical sciences is often hindered by significant depth-dependent signal attenuation and high fluorescent backgrounds. Requiring preparation of well-controlled, largely autofluorescence-free samples, these constraints largely preclude clinical application of fluorescence for most pathologies. To reduce background and increase visibility within cells and through tissue, researchers have successfully pushed fluorescent dye emission further to the near IR through increasing conjugation length. Unfortunately, while organic dyes can be engineered to have many desirable properties, including small size, facile bioconjugation, and tunable toxicity, solubility, targetability, and spectral features, fundamental interactions limit overall brightness. Nanotechnology offers significant opportunities for signal gains when using, for example, quantum dots or plasmon-enhanced emitters, but significant size, bioconjugation, toxicity, and aggregation concerns become paramount.

We have addressed the limited brightness and biocompatibility issues in fluorescence imaging by encapsulated highly fluorescent gold[1] and silver nanoclusters,[2-4] consisting of fewer than 30 metal atoms. These species show excellent brightness and great promise in both single molecule and bulk imaging, while maintaining small overall size.

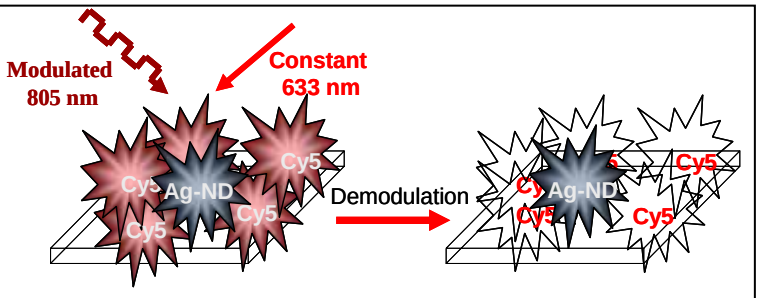

Figure 1. Schematic of modulated Ag nanodot emission and its selective extraction from high background environments upon demodulation.

Still, these species are insufficiently bright for the most demanding applications. Their unique photophysics, however, has enabled optical modulation of their emission that not only increases total emission, but, more importantly, greatly reduces background.[5] Demodulation of nanodot signals enables fluorescence image recovery from within high backgrounds, resulting in order-of-magnitude sensitivity increases. Through detailed understanding of the states involved, we are utilizing these species and translating these concepts to more standard organic fluorophores. These general concepts of removing background through selective fluorescence modulation are applicable to a wide variety of systems, with Ag nanodots[3,5] and modulatable organic dyes[6] being used for biological imaging applications.

1. Zheng, et al., *Ann Rev Phys. Chem* 2007, ***58***, 409-431; 2. Richards, et al. *J. Amer. Chem. Soc.* 2008, ***130***, 5038-5039; 3. Vosch, et al. *Proc. Nat. Acad. Sci. USA*, 2007, ***104***, 12616-12621.; 4. Petty, et al. *J. Amer. Chem. Soc.* 2004, ***126***, 5207-5212; 5. Richards, et al., *J. Amer. Chem. Soc.*, 2009, **131**, 4619-4621; 6. Richards, et al. *J. Amer. Chem. Soc.*, Submitted (2009).

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