

Gold nanoparticles as second harmonic contrast agents for imaging live cells.

NK Balla^{1*}, CJR Sheppard^{2,3}

¹Computational and Systems Biology, Singapore MIT Alliance,
E4-04-10, 4 Engineering Drive 3, National University of Singapore, Singapore
117576

²Division of Bioengineering, National University of Singapore, 7 Engineering Drive
1, Singapore 117576

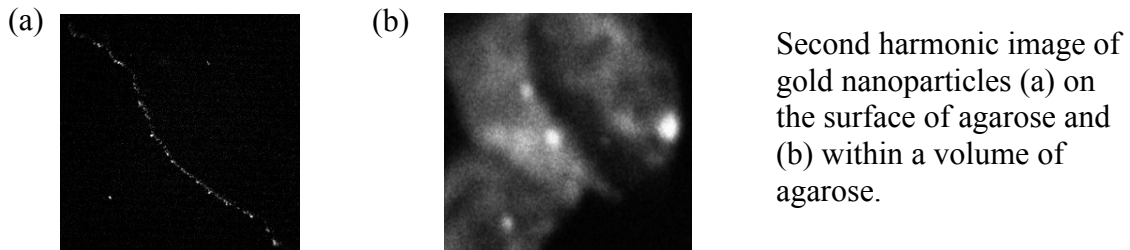
³ Department of Diagnostic Radiology, National University of Singapore,
5 Lower Kent Ridge Road, Singapore 119074

*naveenballa@nus.edu.sg

Keywords: Second harmonic imaging, two photon luminescence, plasmon resonance.

Metal nanoparticles have become quite popular recently as contrast agents for biological imaging. Gold nanoparticles are known for their minimal toxicity [1] and plasmon resonance enhanced contrast [2]. These particles have so far been used for plasmon enhanced scattering [2] and two-photon luminescence [3] (TPL) but not much work has been done with second harmonic (SH) imaging of these particles. Nanospheres, nanorods and nanoshells are the three main kinds of gold nanoparticles used in various imaging modalities. A single nanosphere is a weak emitter of SH signal because of symmetry reasons. But in clusters, nanospheres are strong emitters of SH signal because of local asymmetries. Nanorods by virtue of their inherent asymmetry emit a SH signal. This signal can further be enhanced by coupling with plasmon resonance of these gold nanoparticles.

In the current work, we labeled cells with gold nanoparticles and imaged these particles using a second harmonic microscope. By virtue of their small size, some nanoparticles enter cells without the aid of surface modification. We used both nanospheres and nanorods on two different cell lines. Comparative studies for cell-toxicity, cellular uptake and signal intensity were conducted.



References:

1. Dykman L.A., *et al.*, “Immunogenic properties of colloidal gold”. *Biology Bull.* **31**, 75–79, (2004).
2. Juan Yguerabide, Evangelina E. Yguerabide. “Light-scattering submicroscopic particles as highly fluorescent analogs and their use as tracer labels in clinical and biological applications – I & II”. *Anal. Biochem.* **262**, 137-, (1998).
3. Haifeng Wang, *et al.*, “In vitro and in vivo two-photon luminescence imaging of single gold nanorods”. *Proc. of Nat. Acad. of Sciences* **102**, 15752-76, (2005).