

THREE DIMENSIONAL IMAGING OF CANCEROUS TISSUE PHANTOM USING GOLD NANORODS AS A TWO-PHOTON CONTRAST AGENT

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ABSTRACT

Two-photon imaging is a potentially powerful technique for the early diagnosis of epithelial cancer because it permits non-invasive imaging of subcellular features hundreds of microns deep into scattering tissue. Though it is possible to discriminate cancerous and healthy tissue based on two-photon imaging from endogenous fluorophores, two-photon contrast agents have the ability to increase signal-to-noise ratio, and can be targeted to molecular signatures of interest that may not be fluorescent. We investigate the use of gold nanorods as a contrast agent for two-photon luminescence (TPL) imaging, and find that we can achieve a three orders of magnitude increase in emission intensity in comparison to two-photon autofluorescence (TPAF) imaging. Gold nanorods were prepared using a seed-mediated growth method, conjugated to anti-epidermal growth factor, and labeled to A431 human epithelial skin cancer cells in a collagen matrix tissue phantom. The gold nanorods were synthesized to have a longitudinal surface plasmon resonance of 760nm, which allows for efficient absorption of near-infrared excitation light and bright two-photon luminescence [1]. Figure 1 compares images of TPAF and TPL imaging of cancer cells in our custom-built two-photon microscope [2]. The lack of signal degradation in the nanorod labeled sample with increasing depth compared to the unlabeled sample indicates that for certain concentrations of

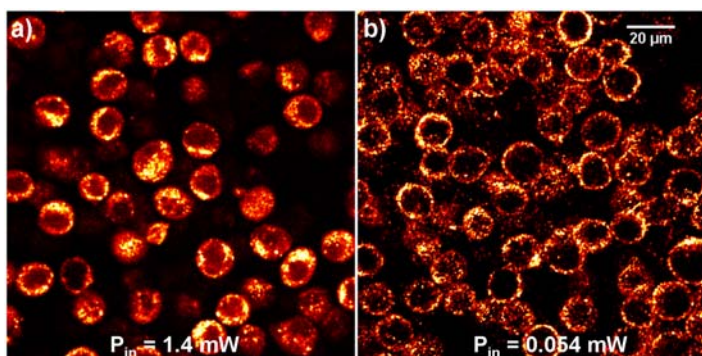


Figure 1: (a) TPAF image of unlabeled cells and (b) TPL image of gold nanorod labeled cells 55 μm into tissue.

gold nanorods, very high emission signal can be achieved without appreciably increasing the bulk scattering coefficient of the sample. Gold nanorods are shown to be a desirable alternative to traditional two-photon contrast agents because of their brightness, ease of synthesis, tunable optical properties, biocompatibility, and resistance to photobleaching.

REFERENCES

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- [2] N.J. Durr, T. Larson, D.K. Smith, B.A. Korgel, K. Sokolov, A. Ben-Yakar "Two-Photon Luminescence Imaging of Cancer Cells using Molecularly Targeted Gold Nanorods" *Submitted for publication*.