AbstractID: 11681 Title: Estimation of Thermal Response of Optically Tunable Gold Nanoparticles Embedded in a Tissue-like Medium

Purpose: To present a recent development on the computational method to estimate thermal response of optically tunable gold nanoparticles such as nanoshells or nanorods embedded in a tissue-like medium when illuminated by a near-infrared (NIR) laser. **Method and Materials:** The light transport theory with diffusion approximation was initially applied to model the temperature rise within a medium without gold nanoshells as a result of the dissipation of the NIR laser power throughout the medium. Subsequently, the heat generated by individual gold nanoshells due to photothermal effect was calculated and combined with the results for the medium without gold nanoshells to estimate the global elevation of temperature within the gold nanoshell-laden medium. The current computational model was tested for its validity using two different phantom examples, one of which was similar to a previously reported phantom experiment. **Results:** The test demonstrated the capability of the current model in terms of producing qualitatively reasonable results, while it also revealed a number of potential differences in the assumptions for the current model and previous experiment. After an adjustment in the model parameters to properly take into account such differences, the computational results and the experimental data matched reasonably well within the average percentage difference of 10%. **Conclusions:** The calculation of temperature distribution from the heat transfer equation is straightforward with the fine element method using the commercial package. However, obtaining the changed optical constant of medium containing gold nanoshells is not an easy task in routine clinical applications. On the other hand, the method with the heat generated by individual gold nanoshell uses the known optical constants of tissue without gold nanoshells, which makes this modeling more practical in a treatment planning for the clinical use.