Indocyanine green coated gold nanoclusters display enhanced photo-acoustic imaging and photothermal therapy modalities

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A new theranostic agent has been developed using the FDA approved indocyanine green (ICG) dye and gold nanoparticles (AuNPs). Both constituents have separately been characterized previously. Indocyanine green is used as a blood perfusion indicator and can be applied in photo-thermal therapeutic treatment of some tumors. Various AuNPs formulations have been reported and applied in vivo for both imaging and radiosensitizing modalities. A problem present with both substances is fast clearance times due to small particle size and the necessity of high concentrations within the tumor environment to produce contrast. We report the synthesis of a new particle which contains a dense core of 2 nm dodecanethiol coated AuNPs surrounded by multiple layers of ICG. The resultant clusters formed vary in average size from 60 nm to 100 nm, well above the kidney clearance level which may provide for enhanced retention. The fluorescence of ICG on the clusters displayed significant reduction likely due to the quenching of neighboring ICG molecules in the dense ICG coating. However, when excited in the near-IR range, the clusters displayed robust heating effects and produced strong photoacoustic contrast, suggesting that the fluorescence quenching may play a role in these enhanced photo-heating processes. The clusters retained their heating function in serum, while retention of their photoacoustic contrast and overall cluster structure remains to be tested. Future work hopes to characterize the clusters’ effectiveness as a theranostic agent in photoacoustic image guided surgery with post-operative photo-thermal therapy treatment in mouse models.

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