AbstractID: 10494 Title: Dosimetry on gold nanoparticle: A microscopic and macroscopic study using Monte Carlo simulations

Purpose: This study investigated dosimetric characteristics of gold nanoparticle under a photon beam. A single gold nanoparticle (microscopic) and a mixture of gold and water (macroscopic) were considered using Monte Carlo simulations based on the Geant4- and EGSnrc-based code, respectively.

Methods and Materials: A single gold nanoparticle (diameter of 100 nm) was irradiated by photon beams with energies of 35.5keV, 73.3keV, 660keV, 1.2MeV and 6MeV in water. 250 million histories were used in Monte Carlo simulation to record different numbers of interactions (*e.g*. photoelectric and Compton) with and without the gold nanoparticle in water. Moreover, a mixture of gold and water was irradiated with photon beams. The dose enhancement ratios (dose of gold and water mixture/dose of water) were determined with different photon beam energies and concentrations of gold.

Results: With a single gold nanoparticle, the number of photoelectric interaction was about 47 times larger than that of Compton for the 35.5keV photon beams. This was opposite to the 6MeV photon beams, where the number of Compton interaction was about 46.5 times larger than that of the photoelectric. Although the values of ratio were similar, the total number of interactions for the 35.5keV photon beams was in fact 348 times larger than that of the 6MeV. A larger energy deposition was therefore found when the photon beam energy was decreased from the MeV to keV range. This result agreed with that from a gold and water mixture. Moreover, increasing the concentration of gold increased the dose enhancement in water.

Conclusions: Both microscopic and macroscopic study on gold nanoparticle agree that more energy deposition is found when the photon beam energy is decreased from MeV to keV range, due to the increase of photoelectric interaction. A higher concentration of gold can increase the dose enhancement in water.