AbstractID: 11340 Title: Experimental Demonstration of Dose Enhancement due to Gold Nanoparticles and Kilovoltage X-rays using Radio-sensitive Polymer Gel Dosimeter

Purpose: To demonstrate the dose enhancement due to gold nanoparticles and kilovoltage x-rays by experimental measurements using radio-sensitive gel dosimeters.

Method and Materials: The dose enhancement due to gold nanoparticles and kilovoltage x-rays has been well demonstrated through in-vitro, in-vivo, and computational work. However, it has not been clearly shown by any physical measurements over a volume loaded with gold nanoparticles. This study attempted to demonstrate the dose enhancement across the phantom made of radio-sensitive gel, known as MAGIC gel, uniformly mixed with gold nanoparticles at a concentration of 1 % by weight. Specifically, formaldehyde-containing MAGIC gel, reportedly more radio-sensitive than the conventional MAGIC gel, was poured into 2 mL cylindrical plastic containers serving as the phantoms for x-ray irradiation. Seven of them had MAGIC gel only, while the remaining two were filled with MAGIC gel and gold nanoparticles. Each gel phantom was irradiated using 110 kVp x-rays entered into the phantom from six different directions separated by 60˚. The total dose delivered to the phantom ranged from 0 to 30 Gy. One phantom in each group was unirradiated and taken as the control. All phantoms were read using a 7T small animal MR scanner. The inverse T2 relaxation time (i.e., R2 value) for each phantom was plotted against the delivered dose to obtain the calibration curve.

Results: Preliminary results suggest addition of gold nanoparticles to MAGIC gel did not significantly change the R2 value, at least at the currently tested gold concentration level. They also show there was more than 100% dose enhancement across the volume of the phantom.

Conclusion: The current investigation provides, probably for the first time, a solid physical evidence for the dose enhancement under the given conditions. It also provides a strong support for the previous estimation of dose enhancement by the Monte Carlo method.