AbstractID: 13254 Title: Feasibility of Bench-top Polychromatic Cone-Beam X-Ray Fluorescence Computed Tomography (XFCT) for In-phantom Detection of Gold Nanoparticles

Purpose: To examine the feasibility of quantifying concentration and spatial distribution of gold nanoparticles (GNPs) present within a small animal-sized object by applying an x-ray fluorescence computed tomography (XFCT) technique with a bench-top, polychromatic, cone-beam x-ray source. **Method and Materials:** The Monte Carlo code MCNP5 was used to simulate the acquisition of gold fluorescence photons under a polychromatic cone-beam XFCT scenario. Three 1 cm-diameter columns containing saline solution with GNPs (≤ 2% gold by weight) were inserted into a 5 cm-diameter cylindrical PMMA phantom. The phantom was irradiated by a 110 kVp x-ray source, and the resulting gold fluorescence and Compton-scattered photons were collected by a series of 11 energy-sensitive tallies. A maximized-likelihood iterative reconstruction algorithm was implemented to reconstruct the image of GNP distribution. The effects of attenuation of both the primary beam through the phantom and the gold fluorescence photons en route to the detector were corrected during the image reconstruction. The attenuation map of the phantom was known a priori, although it could have been easily measured with a transmission scan. **Results:** An accurate image of the GNP-containing phantom was successfully reconstructed, with both spatial distribution and relative concentration of GNPs well defined. The pixel intensity of regions containing GNPs was linearly proportional to gold concentration, which would allow XFCT technique to quantify the GNP concentration and spatial distribution of an unknown sample. **Conclusion:** This study shows the feasibility of performing XFCT imaging using a bench-top, polychromatic, cone-beam x-ray source. The current approach would make XFCT imaging accessible to applications where a synchrotron-based XFCT imaging may be inapplicable, such as *in vivo* measurements of GNP biodistribution.