

عنوان مقاله:

Imaging properties of $\text{Fe}_3\text{O}_4@Au$ and $\text{Fe}_3\text{O}_4@Bi$ hybrid nanocomposites as contrast agents in spectral X-ray computed tomography: A Monte Carlo simulation study

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خلاصه مقاله:

Objective(s): In this paper, we evaluated some imaging properties of $\text{Fe}_3\text{O}_4@Au$ and $\text{Fe}_3\text{O}_4@Bi$ hybrid nanocomposites as contrast agents in spectral CT. For this purpose, we simulated a spectral CT scanner with photon-counting detectors (PCDs) in 6 energy bins by a Monte Carlo simulator. **Materials and Methods:** A cylindrical phantom was designed with a diameter of 8 cm and a height of 10 cm. $\text{Fe}_3\text{O}_4@Au$ and $\text{Fe}_3\text{O}_4@Bi$ hybrid nanocomposites were designed as a core-shell with a diameter of 80 nm. Simulation results were utilized to reconstruct cross-sectional images through the filtered back-projection (FBP) algorithm in MATLAB software. Signal intensity and contrast to noise ratio (CNR) of tested contrast agents were calculated in spectral CT images. **Results:** The results indicated a comparable image quality for $\text{Fe}_3\text{O}_4@Au$ and $\text{Fe}_3\text{O}_4@Bi$ hybrid nanocomposites at different energy bins. However, in the energy range of 80 to 120 keV (bin 4 and 5), the difference in signal intensity and CNR between these two nanocomposites increased. The maximum signal intensity and CNR for $\text{Fe}_3\text{O}_4@Au$ and $\text{Fe}_3\text{O}_4@Bi$ were acquired at the highest concentration. The maximum signal intensity for $\text{Fe}_3\text{O}_4@Au$ was 144 ± 10 (HU) in the 4th energy bin and for $\text{Fe}_3\text{O}_4@Bi$ 162 ± 19 (HU) in the 5th energy bin. Besides, the maximum CNRs of 74 ± 6 and 67.5 ± 9 for $\text{Fe}_3\text{O}_4@Au$ in bin 4, while for $\text{Fe}_3\text{O}_4@Bi$ in bin 5 were obtained respectively. **Conclusion:** Based on our results, $\text{Fe}_3\text{O}_4@Au$ and $\text{Fe}_3\text{O}_4@Bi$ hybrid nanocomposites have provided promising results as contrast agents in spectral CT. $\text{Fe}_3\text{O}_4@Bi$ nanocomposites are recommended due to their lower price and availability.

کلمات کلیدی:

bismuth nanoparticles, Gold Nanoparticles, Hybrid nanocomposites, Iron oxide nanoparticles, Spectral computed tomography

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