Filter Material Optimization to Increase Sensitivity of Gadolinium X-ray Fluorescence Spectrum

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Keywords: X-ray fluorescence imaging, molecular imaging, metal nanoparticle, Monte Carlo simulation

X-ray fluorescence-based imaging technique is a promising imaging modality to identify *in vivo* biodistribution of metal nanoparticles (MNP). In particular, studies on X-ray fluorescence computed tomography (XFCT) and X-ray fluorescence imaging (XRF imaging) are actively being discussed. XFCT acquires the *in vivo* biodistribution of MNPs using the principle of CT. In contrast, XRF imaging uses a 2D array detector to directly obtain the *in vivo* biodistribution of MNPs without any image reconstruction process. There are many challenges to improve the performance of the XRF based molecular imaging modalities. Among them, the most significant is to improve the detection limit. It is because the detection limit should be a comparable level to other existing molecular imaging modalities. Many research groups have made several attempts to improve sensitivity not only in terms of hardware but also in terms of software. In this study, incident X-ray filter material was optimized to improve the pinhole XRF imaging system's sensitivity. The experimental setup was simulated using Monte Carlo N-Particle Version 6.2 (MCNP6.2). More realistic simulation results were obtained by matching experiment and simulation results. XRF images were acquired using various filter materials, and the optimal filter material was determined through quantitative evaluation. After passing through the smooth process by the Gaussian filter, the MC origin result and the experimental result are very similar.

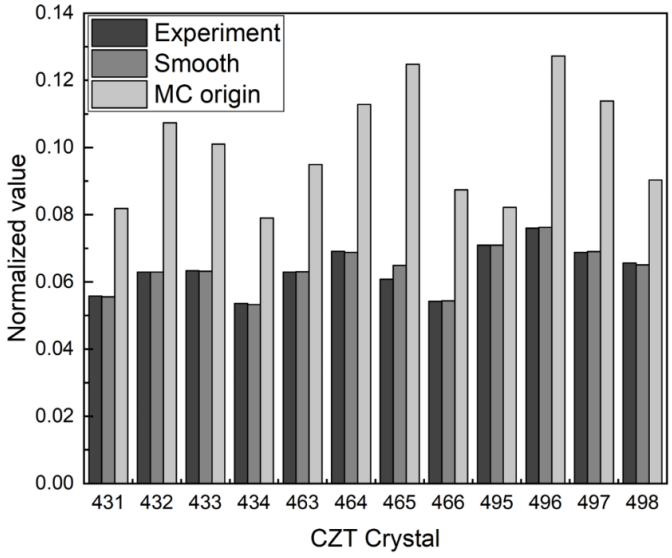

Fig. 1. Spectrum matching was obtained by Monte Carlo simulation, experiment, and gaussian smoothing.

Acknowledgments
None.