

**Evaluation of uranium and plutonium in simulated blood extracted from wounds
by X-ray fluorescence analysis**

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Workers in nuclear fuel handling facilities have a finite risk of injury and wound contamination from actinides such as uranium (U) and plutonium (Pu). When such contamination occurs, medical doctors determine the appropriate course of treatment (surgical resection of tissue in the contaminated wound, administration of a decontamination agent, or other regimen). Their decision is based on the types and amounts of α -emitting actinide contaminants, which can lead to serious internal exposure when accidentally intake take place. Although surgically resecting the tissue in the contaminated wound can suppress additional actinide intake, rapid quantification of the actinides in the wound may be useful to avoid unnecessary surgeries. The rapid detection of actinides is usually performed by the α -particle counting method. However, in cases of wound contamination, most of the α -particles cannot pass through the blood oozing from the wound. In our previous study, we developed a new method that rapidly detects U in wounds based on X-ray fluorescence analysis of contaminated blood collected by a filter paper [1]. In our preliminary experiment, we showed that this technique is also applicable to blood contaminated with Pu. However, in facilities such as spent nuclear fuel reprocessing plants, Pu and U are often handled together, and the concentration ratio of the two elements depends on the work process. Therefore, the simultaneous quantification of U and Pu in wounds is required for radiation emergency medicine in these nuclear facilities. The energy difference between the U $L\alpha$ (13.6 keV) and Pu $L\alpha$ (14.3 keV) peaks is larger than the energy resolution of the detector (~ 275 eV at Mo $K\alpha$); moreover, these peaks little affect each other when the concentrations of their causative elements are comparable. However, when the U concentration is much higher than the Pu concentration, the background in the energy region of the Pu $L\alpha$ peak may increase. In addition, as U and Pu are excited by incident X-rays of the similar energy, the peak intensity of Pu $L\alpha$ can be lower in a sample containing a large amount of U and a small amount of Pu than in a sample containing the same amount of Pu alone.

In this study, the model samples for X-ray spectrometry analysis were contaminated with U and Pu over a wide range of concentration ratios. The samples were prepared by mixing uranium- and plutonium nitrate solutions of various mixing ratios and dropping them onto filter papers. We discuss not only the minimum detection limits for U and Pu, but also the range of Pu/U ratios that can be adequately determined by the above method.

[1] Izumoto et al., X-ray spectrometry, in press.