XRF ANALYSIS OF THE DISTRIBUTION OF HEAVY METAL IONS IN CANCEROUS TISSUES

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Heavy metal ions have been used as markers for pharmaceutical compounds to track how these compounds are transported and metabolized in the body. However, it is also possible to use these ions to capture thermal neutrons. This has lead to the testing and development of neutron-capture therapies for certain types of cancers. The ion-containing compound is tailored for preferential uptake by cancer cells. Under neutron bombardment, the ensuing nuclear reactions at the ion sites can be used to destroy the cancerous cells in the immediate vicinity of the reaction, hence, "focusing" the neutron energy on the cancer cells.

To estimate the captured energy distribution throughout the body, it is necessary to know exactly the position of the neutron-capturing atoms. The examination of biological cell structures is possible with different optical microscopic methods. But, these methods give no information about the distribution of the heavy metal ions in the cells. Another possibility is elemental-mapping with micro-analytical methods, i.e. the determination of the elemental distribution by excitation of x-ray fluorescence within a small volume. This excitation is typically done with electron beams. But, for these types of biological tissue samples, electron beams have not been useful for a number of reasons, i.e. trace sensitivity of electron beam methods is not sufficient; the samples cannot be measured under vacuum; and the electron beam is destructive to the sample. Micro-beam x-ray fluorescence can open a new way for this type of study. Excitation with x-rays gives a higher sensitivity for low concentrations and allows the possibility for measurement in an air atmosphere. Furthermore, the focussing of exciting radiation with capillary optics generates a high-intensity, small analytical spot size. In this paper, the goals of this micro-XRF study will be discussed and results of measurements on tissues will be presented.