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Multi-energy X-ray imaging for high-Z elements identification

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Material decomposition of sample components can be performed using multi-energy or multi-threshold X-ray imaging. The hybrid semiconductor photon counting pixel detectors of the Medipix family are highly convenient for this application as they enable dual- or multi-threshold imaging (Medipix3) or fully spectral imaging (Timepix3). We have proven that various types of materials can be identified based on their material response extracted from two or more images measured with different thresholds.
The K-edge imaging method gives even more analytic approach to identification of a specific element within the unknown sample matter. It is based on the fact that there is a sudden increase of the X-ray absorption at certain energy (absorption edge), which is characteristic for given element. The exact implementation of this method depends on the type of sample and number of elements to be identified. Especially for high-Z elements, where also high-Z sensor material is required for efficient detection (e.g. CdTe), the K-edge imaging becomes difficult to implement due to high absorption combined with Compton scattering in both the sample and the detector as well as the X-ray fluorescence within the sensor material. The Medipix- and Timepix-based detectors take advantage of the possibility of suppressing the unwanted effects by suitable multi-thresholding or original spectra reconstruction.
We demonstrate the K-edge based identification of selected high-Z element within a material mixture. The sample is decomposed into components and the content of the selected element is calculated. The K-edge based approach can be used in many practical applications including inspection of element concentration within ore in the mining industry.

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