The determination of copper speciation in breast tumor tissue using a compact, short focal distance bent crystal Laue analyzer

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Abstract:
Copper plays an important role in angiogenesis and tumor growth. The anti-growth action of copper chelators is mainly their induced inhibition of angiogenesis. Cu is considered as a target for novel cancer therapies that offer lower level of toxicity compared to current available chemotherapies. Although Cu oxidation state has not been directly implicated as being a characteristic of the tumor growth process, this can not be completed excluded as a potential role of Cu in tumor growth. X-ray microprobe fluorescence spectroscopy can detect very low metal concentrations with high efficiency and identify oxidation states and coordination chemistry using spectral lines that are normally unresolved by other techniques. It is very difficult to analyze where the sample contains a dilute mixture of different Cu species with very similar spectral features. The mixture could be composed by Cu(I) and a relatively low concentration of Cu(II) species, which can be easily masked by the Cu(I) component, making their identification very difficult. To overcome these limitations a high energy resolution and high efficiency compact, short focal distance Bent Crystal Laue Analyzer (BCLA) detection system has been developed for copper speciation in biological samples. The analyzer has energy resolution of 18 eV@ Cu Kα line and it has notable advantages to resolve the Cu Kα1, Kα2 and Kβ fluorescence lines while offering a very low background. The design involved a selection of the proper silicon crystal's thickness and bending curve to achieve an optimized energy resolution and sample-to-analyzer distance (~50mm) with detection limit of 10ppm. This paper reports the results of new BCLA analyzer with representative microXAS results from model compound samples and breast cancer tissue.