

Arsenic Distribution and Speciation in the Arsenic Hyperaccumulator Fern by micro-XRF imaging and micro-XANES analysis

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Some specific kinds of plants are known as the hyperaccumulator for heavy metals. It was reported that, for example, Chinese brake fern (*Pteris vittata* L.) contained large amounts of arsenic (As: ca. 22,000 $\mu\text{g g}^{-1}$ dry weight) when they grew in the contaminated soils [1]. It is quite interesting to know how they efficiently extract such a toxic heavy element from the contaminated soil into its fronds. Studies on the distribution and chemical form of As are increasing recently, however only limited information is available as to the chemical behavior of arsenic in the fern in relation to the function of the plant tissue and organs. In the present study, microbeam synchrotron-radiation X-ray fluorescence (μ -SR-XRF) analysis was applied to the hyperaccumulator for As in order to reveal the distribution of toxic heavy elements in their tissues and cells and to investigate their physiology and accumulation mechanism.

The Chinese brake fern cultivated in a culture medium containing As was subjected to the analysis. The samples were prepared by microtome as a slice of tissues. The μ -SR-XRF imaging was carried out at BL37XU of SPring-8, JASRI and at BL4A of PF. Monochromatic X-ray microbeam (beam size $< 2 \times 5 \mu\text{m}^2$) was produced by Fresnel zone plates[2] or K-B mirror. The chemical form of As in plant tissue was investigated by micro-XANES analysis of As K-edge.

The two-dimensional distributions of As and some trace elements in the plant tissue and cells were clarified. It was demonstrated that As accumulated in the vascular tissue and the neighboring tissue of spore. The results from micro-XANES of fern tissue showed that As(V) in the culture medium was reduced to As(III) in the tissue after absorption.

[1] L.Q. Ma, K.M. Komar, C. Tu, W. Zhang, and Y. Cai, *Nature*, **409**, 579 (2001)

[2] Y. Suzuki et al., *Jpn. J. Appl. Phys.*, **40**, 1508 (2001).