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Study of moss as air pollution monitor by SRXRF microprobe technique

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Introduction

Moss is widely accepted as one of the susceptible monitors for indicating air pollution due to its characteristics of sensitivity, accuracy, and directness.

For all biomonitors, the mechanisms of absorption and retention for trace elements are still not sufficiently known. The Synchrotron Radiation X-ray fluorescence (SRXRF) technique has proved to be appropriate for the analysis of trace elements in bioindicators, being multi-element, reliable, extremely sensitive for almost all interesting elements, matrix independent and suitable for a large concentration range.

Experimental method

Sample exposure

The moss sample named *Bryum capillare* Hedw., which was widely distributed in the south-east of China, was chosen and collected. The mosses were divided two groups and packed into the Nylon mesh fabric bags respectively. One bag as a control group was put on the rooftop (15m) of laboratory building at Shanghai Institute of Applied Physics (SIAP), and subjected to atmosphere exposure. Another as a polluting group was put on the rooftop (16m) of air monitoring station at Shanghai Institute of Steel Research (SISR) located in Wusong industrial district. The samples of two groups were exposed for one month simultaneously.

SRXRF scanning microprobe

A fluorescence microprobe technique was used to scan the distributions of trace elements in stem slice and leaf. By using a Kirkpatrick-Baez focusing mirror system, the incident light became a micro beam of 5 μm × 5 μm. A sample platform of two-dimension controlled by computer was installed. The whole scanning analysis system operated by an online computer was used to collect spectrum point by point automatically. In experimental, each sample was put regularly on the moving platform and scanned along an interesting range by incidence X-ray. A recording of elemental image was performed by using the software.

Results and discussion

The distributions of metal elements of Pb, Cu, Fe, Ni, Mn, Zn, Ca and K in the micro area of leaf and stem slice were determined. Figure 1 demonstrated that there were low elemental concentrations in the cells of epidermis and central marrow, but there were high elemental concentrations in the cells of cortex. Because moss did not have the vascular tissue, which transported the moisture and the nurture, thus both roles of transport and storage of the nurtures were only completed by cortex cells. Figure 2 showed the distributions of K and Pb in a micro-area of *Bryum capillare* leaf under different exposures. Under SIAP normal atmospheric environment (a), the growth of moss's leaf was good, and its absorption to toxic element Pb was concentrated mainly in the midrib part. Except midrib, Pb concentration was very low and distributed in the chloroplast cell evenly. However, the mosses exposed under SISR were suffered an excessive pollution of heavy metals (b). The leaves absorbed a lot of Pb, and its physique became small and slow-growing. Due to the toxicity of Pb and the antagonism between elements, the concentrations of nutrient elements, such as K in Fig.2, had been rarely remained in leaves. This meant that the leaves already lost their capacity to absorb nutritive elements.

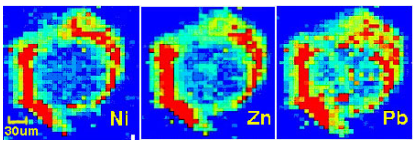

Fig.1 Ni, Zn and Pb distributions in a slice of *Bryum capillare* stem

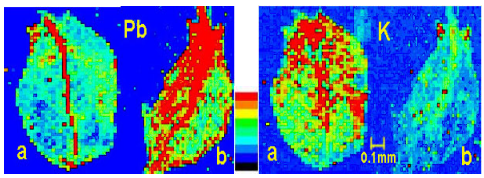

Fig.2 K and Pb distributions in a micro-area of *Bryum capillare* leaf under different exposures

Conclusions

The research demonstrates that mosses have an accumulative ability to store the contaminants in their tissues and can be used to monitor such contaminants in the atmospheric environment. Bioaccumulation is the result of the equilibrium process of intaking from and discharging into the surrounding environment.

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