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XANES study of chemical states of I accumulated by *Dactylis glomerata*

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Introduction

Radioiodine is known to be highly concentrated in the human thyroid gland. We should clarify the environmental behavior of radioiodine released from the stacks of nuclear facilities to the environment. The pathway of radioiodine from soil to the human bodies via soil plant (agricultural products) is one of the important ones [1].

The chemical states of iodine in environment are iodide (I^-) and iodate (IO_3^-). The solution-to-spinach leaf transfer factors of iodate is higher than that of iodine [2]. This result suggests that transport of iodine from soil to plant is different between iodide and iodate. However, only a little is known about the transport mechanism of iodine by plant from soil.

In this study, we investigated the change of chemical states of iodide and iodate during the transport from water to plant. The oxidation state of I accumulated in leaf was investigated using XANES.

Methods

We used *Dactylis glomerata* as a model plant. A hydroponic experiment was carried out to investigate the transport of I from water to plant. *Dactylis glomerata* was grown in solution containing 2 mM KNO_3, 2 mM NH_4NO_3, 2 mM $MgSO_4$, 0.6 mM $CaCl_2$, 0.5 mM KH_2PO_4, 25 μM FeNaEDTA, 10 μM H_3BO_3, 2 μM $MnSO_4$, 1 μM $ZnSO_4$, 0.2 μM CuCl2, 0.05 μM Na_2MoO_4. After *Dactylis glomerata* was grown for 7 days, iodine of 2000 ppm was added in the solution. Leaf was harvested after 2 days for Co K-edge XANES analysis. The leaf was freeze dried immediately after the harvest, and kept in freezer.

Iodine L_{III}-edge XANES spectra for the leaf samples were collected at beamline 9A at Photon Factory. KI and KIO_3 solution were measured as standard materials. The samples were collected in fluorescence mode. The fluorescence yield of each sample was monitored using a 19-element Ge solid-state detector (SSD). All the measurements were carried out at room temperature.

Results and discussion

Iodine L_{III}-edge XANES spectra are shown in Fig. 1. The peak top of iodine solution is located around 4560.6 eV, whereas iodate indicate the peak tops around 4561.5 eV. Visual inspection of Fig. 1 showed that XANES spectra of the leaf samples are resemble to that of iodide. Interestingly, the oxidation state of iodine accumulated in leaf was I(-1), even though *Dactylis glomerata* was grown in the solution containing iodate. These results indicate that chemical states of iodate was changed by the transport from the solution to the plant.

Previous work reported that oxidation state of iodine in the solution after cultivation of Komatsuna, *Brassica Rapa var. pervidis* was -1 [1]. They suggested the chemical state of iodine in plant is iodide. Our result showed the direct evidence of the chemical state change from iodate to iodide during transport from the solution to plant. The detail mechanism is clarified by the further experiments.

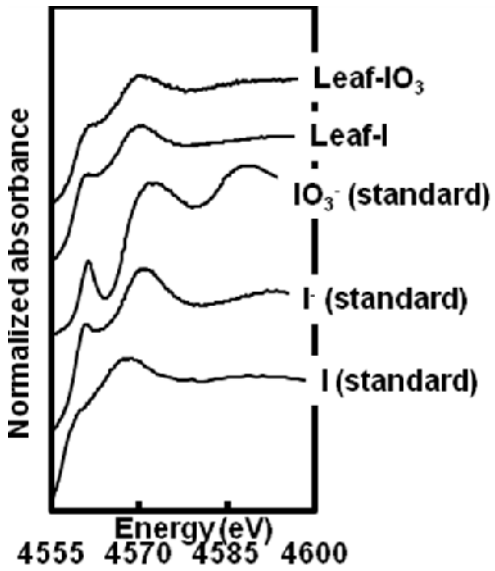

Fig. 1. Iodine L_{III}-edge XANES spectra of the leaf of *Dactylis glomerata* grew in the solution containing iodide or iodate

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References

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