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XAFS analysis of zirconium adsorbed on various dry yeasts

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1 Introduction

By the research and development of nuclear engineering field, various kinds of liquid wastes containing uranium has been accumulated. Uranium is harmful to organisms because of having its toxicity and radioactivity, and must be controlled from the point of view of nuclear safeguard. Therefore, it is necessary that stabilization remove uranium from uranium liquid waste. In previous studies, we have confirmed that baker's yeast exhibits excellent adsorption performance for various metal ions [1].

Investigation of the adsorption mechanism of baker's yeast for Mo in nitric acid solution has revealed that it binds to carboxy groups in the $[MoO_2]^{2+}$ chemical form [2]. However, the interaction of other metal ions with various functional groups in yeast has not been investigated. Therefore, in this study, we have focused on the adsorption mechanism by EXAFS analysis for Zr, that is known to be adsorbed on baker's yeast.

2 Experiment

In the zirconium adsorption experiment, six types of yeasts (baker's yeast, torula yeast, beer yeast, chromium yeast, selenium yeast (1000 ppm),selenium yeast (2000 ppm)) were added to a shaking solution with a zirconium concentration of 10mM. (nitric acid concentration in 2 M) at 18/1 g/L solid/liquid in a 50 mL PP centrifuge tube and shake at 180 rpm for 3 h. After shaking, the solid phase was washed with purified water and dried in a constant temperature dryer at 40°C for 24 hours or more.

For XAFS measurement, the dry solid phase was packed into a made of the PP Unipack. The shaking solution was packed in a made of PP Unipack containing an acrylic spacer with an optical path length of 15 mm.

XAFS measurement of these samples have carried out by the transmission method at Photon Factory BL-27B of KEK. The XAFS spectra was analyzed by the software xTunes [3]. The evaluation of the adsorption mechanism of zirconium was evaluated from the peaks of the neigh boring elements of each radial structure function obtained.

3 Results and Discussion

Figure 1(a) shows XAFS oscillations an Figure 1(b) shows the radial structure functions for zirconium in samples obtained from adsorption experiments, respectively. The radial structure function of zirconium in the shaking solution and each yeast showed similar peak shapes in the range up to 3 Å. Therefore, it is considered that the zirconium complex in solution adsorbed on each yeast is similar each other. When $ZrO(NO_3)_2$ is dissolved in nitric acid, the atom coordinating to the first coordination sphere of zirconium is to be oxygen [4].

Therefore, the first coordination sphere of zirconium in the each yeast is coordinated by oxygen atoms due to the Zr-O bond.

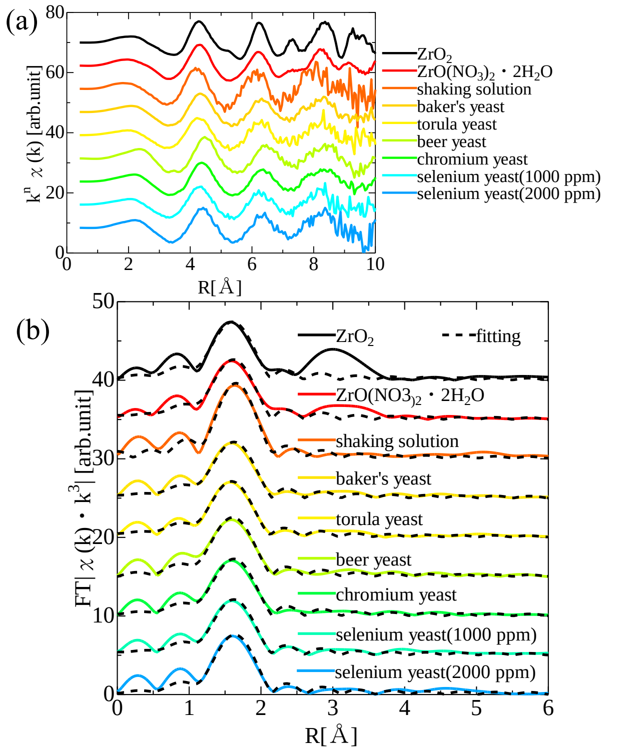

Figure 1. EXAFS structure functions of zirconium K-edge adsorbed on various yeasts. (a) $k^3\chi(k)$ functions and (b) corresponding FT

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