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# X-ray imaging observation of cesium at heating process

Yoshihiro Okamoto[1,*] Takeshi Osugi[1], Mitsuo Akabori[1], and Hiroaki Nitani[2]
[1]JAEA, Tokai-mura 319-1195, Japan
[2]Photon Factory, KEK, Tsukuba 305-0801, Japan

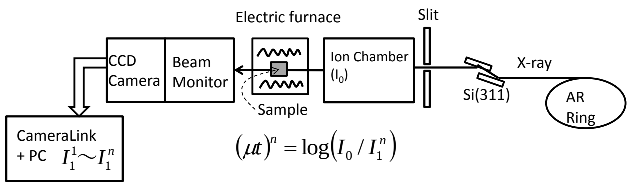
## 1 Introduction

Incineration of environmental samples including radioactive cesium released by the accident of the Fukushima Daiichi Nuclear Power Plant is important to decrease a volume of ash wastes. On the other hand, the incineration process is accompanied by a risk of the re-scattering of cesium. It is more effective to prevent releasing cesium at high-temperature state (even at molten state), although it is important to capture cesium.

We have studied mixing effects of ash and clay minerals. From systematic XAFS measurement of some mixtures, we found that vermiculite adsorbed cesium strongly. In the present work, we tried to observe behavior of cesium in the sample at heating process by using X-ray imaging technique.

## 2 Experiment

X-ray imaging measurement was performed at the NW10A station of PF-AR. The imaging system (Hamamatsu Photonics,K.K.) which consists of the beam monitor and the high-sensitive CCD camera is used in place of an ion chamber as shown in Fig.1 [1]. The image from the CCD camera was stored as 16bit TIFF files. The resolution of this imaging system is 10μm.




Fi.1 : Layout of the X-ray imaging measurement

The sample was a mixture of incinerated ash containing cesium and vermiculite. It was heated from room temperature to 1500℃ with an air atmosphere. X-ray absorption images of the sample was recorded by 11 times energy scanning from 35.9 to 36.3keV (K-edge energy of cesium element is $E_0$=35.985keV). Cesium is emphasized as black color on the CCD image after the Cs K-edge energy.

## 3 Results and Discussion

CCD images taken at E=36.02keV which is just over the Cs K-edge are shown in Fig.2. Cesium hardly moved less than 1000 ℃ , since the monochrome intensity distribution on the CCD image did not change. It can be seen that a change of the distribution of cesium occurred above 1000℃. The shrinkage of the sample began with melting above 1300℃. Most of cesium still remained in the sample, since color of the sample at 1423 ℃ is sufficiently black. The sample disappeared from the CCD image area at 1500℃.

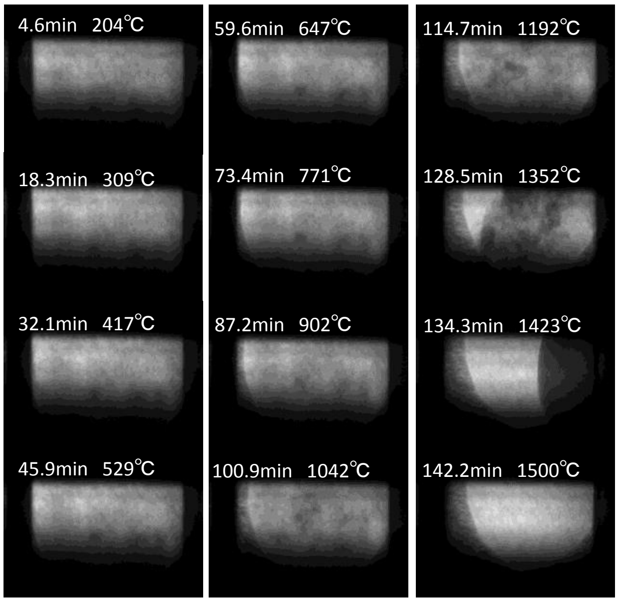



Fig. 2: CCD images at heating taken at E=36.02keV

The CCD image at room temperature taken after the heating measurement is shown in Fig.3 The sample attached to the sidewall of the sample container by melting and solidifying. We confirmed the frozen sample contains sufficient amount of cesium. It is concluded that cesium can be kept in the sample by mixing with vermiculite.

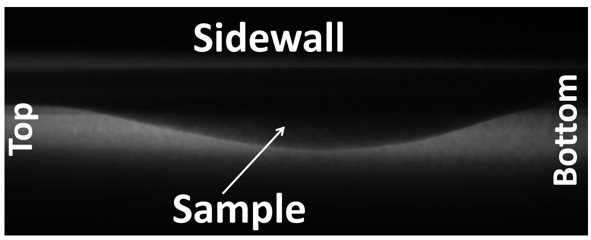



Fig. 3: CCD image of the sample cell after heating taken at E=36.02keV

## References

[1] Y. Okamoto *et al.*, Trans. Atom. Energ. Soc. Jpn. **11** (2012) 127.

* okamoto.yoshihiro@jaea.go.jp