Overview of the radioactive particles in the Fukushima accident

Y. SATOU[1*], K. SUEKI[1], K. SASA[1], I. NAKAI[2], Y. ABE[2], Y. IIZAWA[2], T. ONO[2], K. ADACHI[3] AND Y. IGARASHI[3]

[1] Fuculty of Pure and Applied Sciences, University of Tsukuba, Tsukuba, Ibaraki 305-8577, Japan (*correspondence: yukihiko@ied.tsukuba.ac.jp)
[2]Faculty of Science, Tokyo University of Science, Shinjuku, Tokyo 162-0825 Japan
[3]Meteorological Research Institute, Tsukuba, Ibaraki 305-0052, Japan

In March 2011, the Fukushima Dai-ichi Nuclear Power Plant (F1NPP) accident occurred, and consequently large amount of radionuclides were discharged to the environment. Especially Cesium-137 (^{137}Cs), which is radioisotope of cesium and has 30 year of half-life, will remain in the environment for a long time. Understanding of the physical and chemical properties of the emitted radioactive cesium is important to accurately evaluate the possible human health impacts and to assess the long-term distributions of these radionuclides after deposition in the residential areas, agricultural fields, mountains, and aquatic environments.

Early stage of the accident, Cs-bearing radioactive particles were detected at the Tsukuba, which is located at 170 km south from the F1NPP (Adachi et al., 2013). Characteristic X-rays of Cs were detected from several particles by the EDS analysis. After this novel discovery, Abe et al. (2014) applied a synchrotron radiation (SR)-micro(μ)-X-ray for analysis of the particles. They concluded that the particles: (1) contained elements derived from nuclear fission processes and from nuclear reactor and fuel materials; (2) were amorphous; (3) were highly oxidized; and (4) consisted of glassy spherules formed from a molten mixture of nuclear fuel and reactor material.

Satou et al. (2015) and Yamaguchi et al. (2016) isolated these particles from environmental samples collected at the Fukushima prefecture and identified that the dominant element of the particle is silicate. In addition, SR-μ-X-Ray Fluorescence (XRF) analysis revealed presence of U in several particles, though U is a minor component (Satou et al., 2015). Therefore the radioactive particles in the Fukushima accident were rather different from so-called hot particles,which is a fragment of U, observed at the Chernobyl Nuclear Power Plant accident in 1986.