Performance Evaluation of All-Solid-State Batteries in a Radiation Environment

＊Weichen Zhang[1], Hiroshige Kikura[2], Yutaka Tamaura[3] and Tadashi Kawamoto[3]

[1]Tokyo Tech., [2]ZC Lab., [3]Tamaura Labo

Abstract

In this study, we tested all-solid-state batteries in a high-radiation environment exceeding 100 Gy using a cobalt-60 chamber. Evaluations with potential measurements during charge-discharge cycles and pulse ultrasonic methods showed no significant electrical performance degradation. Durability tests revealed almost no material degradation after one hour of irradiation exposure.

Keywords: All-solid-state batteries, High-radiation environment, Pulse ultrasound, Cobalt-60

1. Introduction

Due to their high energy density and safety, all-solid-state batteries (ASSBs) are being considered for next-generation energy storage. The Fukushima Daiichi nuclear power plant accident increased robot use for nuclear waste management [1][2]. Safe and reliable power sources are needed for these robots. ASSBs are promising candidates for this application. ASSB performance in nuclear radiation environments is examined in this study.

2. Experimental equipment and results

Figure 1 shows the photo of radiation measurement system. This measurement system has a charger and discharger. Software "Charge Master V1.19" controls charging and discharging. This experiment used battery with 7500mAh, and 15,000mAh. At 25°C, the battery temperature and discharge current are constant during measurements. Figure 2 shows the current voltage and capacity result for the discharging process of ASSBs under radiation environments. The change is little compare with the results when battery is under no radiation environment.

Fig.1 Experiment setup for radiation measurement

3. Conclusion

This study examined ASSBs performance in nuclear radiation. ASSBs are radiation-resistant and discharge normally under radiation conditions. ASSBs retained discharge performance and internal structural stability after radiation exposure, according to experiments. This suggests that ASSBs can power nuclear waste disposal robots and other radiation-sensitive applications.
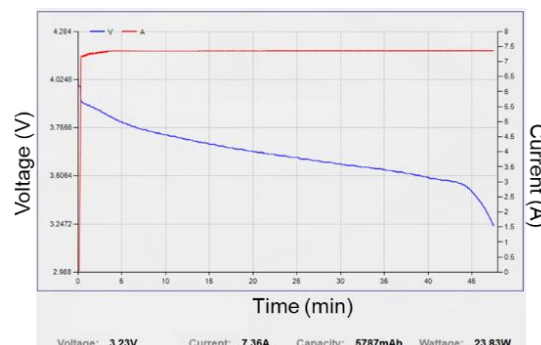

Fig.2 Electric result for discharging
(Radiation 44Gy/h)

References

[1] Jonathan M. Aitken, Autonomous Nuclear Waste Management, *IEEE Intelligent Systems* (2018), Vol.33, pp.47-55.

[2] Ivan Vitanov, A Suite of Robotic Solutions for Nuclear Waste Decommissioning, *Robotics* (2021), Vol.10(4), 112.