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IMPROVEMENT OF LOW TEMPERATURE RATE PERFORMANCE OF GRAPHITE ANODE OF LITHIUM ION BATTERY THROUGH THE COAL TAR DERIVED AMORPHOUS CARBON COATING

Hiroki Shimanoe[1*], Hideki Nakashima[1], Kazuki Ito[1], Koji Nakabayashi[1, 2], Jin Miyawaki[1, 2], Seong-Ho Yoon[1, 2]

[1] *Interdisciplinary Graduate School of Engineering Science, Kyushu University, Kasuga, JAPAN*
[2] *Institute for Materials Chemistry and Engineering, Kyushu University, Kasuga, JAPAN*

*Presenting author's e-mail: 3ES17003K@s.kyushu-u.ac.jp

Introduction

The application markets of Li-ion battery (LIB) is rapidly increasing in the industrial areas such as energy storage system (ESS) and electric vehicle (EVs). There is still much room for improvement in the use of LIB at various environments. Especially, the rate performance of LIB decreased at low temperature due to an increase of internal resistance. In previous study, we reported that coal tar derived amorphous carbon coating on the surface of graphite anode was very effective to improve the rate performance at room temperature [1]. Also, we reported the removal of volatile matters which was determined as hexane soluble (HS) of the precursor coal tar pitch was very effective to obtain the much improved effect of rate performance [1].
In this study, we examined the effect of coal tar derived amorphous carbon coating on the surface of graphite anode on the discharge rate performance of LIB at the relatively low temperature range of 0ºC~10ºC.

Materials and Methods

Natural graphite (NG), 10 wt.% coal tar pitch (CTP, SP=150℃) and its HS removed 10 wt.% CTP-HI were mixed for 24 h in tetrahydrofuran (THF). After removing THF, the samples were heat-treated in two conditions, at 800℃ for 30 min in an Ar atmosphere, at 1000 and 1600℃ for 10 min under vacuum. The anode of LIB was prepared by mixing sample, CB, SBR and CMC at ratio of 85/5/5/5 (w/w/w/w). After preparing the LIB coin cell, we examined the discharge rate performance of LIB at the relatively low temperature range of 0ºC~10ºC (Charge: 0.1 C, Discharge: 0.1-5 C, 1 C: 372 mA).

Results and Discussion

Figure 1 showed the discharge rate performance at 0, 10, 25ºC and discharge curves at 10ºC using 10 wt.% CTP and CTP-HI derived amorphous carbon coating on the surface of graphite anode. The decrease of capacity at 25ºC was suppressed by coating amorphous carbon on surface of natural graphite. At 0 and 10℃, the anode coated CTP-HI at 1600℃ exhibited higher capacity than other anode because the mobility of Li-ion on the surface of anode increased due to the development of amorphous structure. The result of discharge curves at 10ºC exhibited the voltage rises was suppressed through coating amorphous carbon.

Conclusions

Coating amorphous carbon on the surface of NG as an anode could suppress an increase of internal resistance and enhanced the discharge rate performance at low temperature. Especially, LIB using NG coated with CTP-HI and heat-treated at 1600℃ exhibited high rate performance.

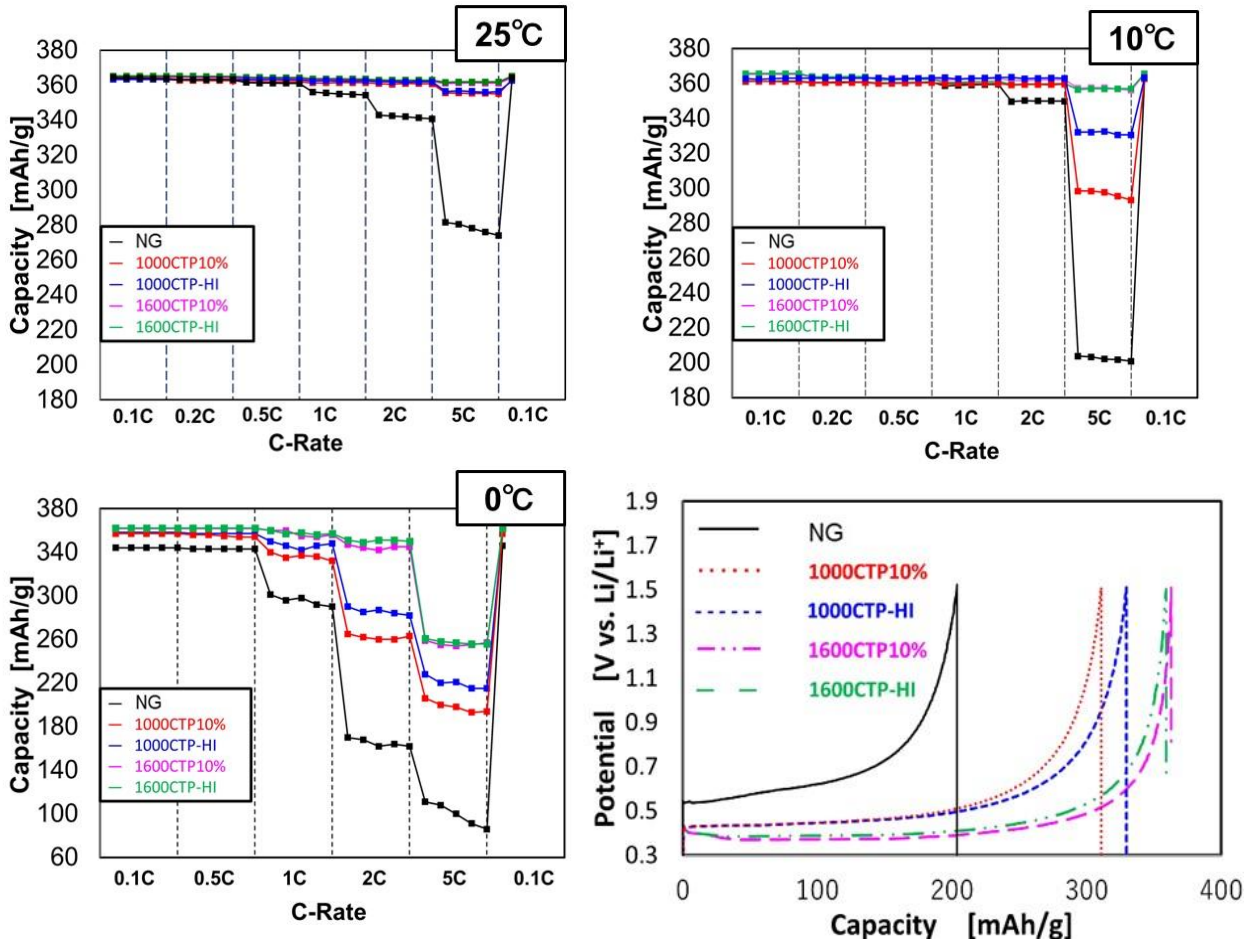

Figure 1. Rate performance at various temperature and discharge curves at 10°C using NG coated amorphous carbon.

Acknowledgment

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References

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