

Application News

No. 072

Total Organic Carbon Analysis

Carbon Measurement of Metal Powder Battery Material

Various metal powders are used in battery electrode materials, depending on the type. Because batteries are used in large quantities in familiar products such as mobile phones, notebook computers, and automobiles, a high level of safety is necessary. Therefore, high purity is demanded in the metal materials used as materials.

Quick, simple measurement of the concentration of carbon contained in metal powders is possible by using a Shimadzu total organic carbon (TOC) solid sample system.

This article introduces an example of total carbon measurement of lithium cobalt oxide, which is widely used as a positive electrode material in lithium ion batteries, by using Shimadzu solid sample system consisting of a TOC-L_{CPH} total organic carbon analyzer and SSM-5000A solid sample combustion unit.

M. Tanaka

■ Analysis Method

Approximately 100 mg of a commercial lithium cobalt oxide (Fig. 2) powder reagent was placed in the sample boat of the SSM-5000A and weighed, and total carbon (TC) was measured. Next, analysis samples were prepared by adding glucose as a carbonaceous substance to 100 mg to 200 mg of lithium cobalt oxide so as to obtain carbon concentrations of 5.0 %, 1.0 %, and 0.2 %, and the TC of the samples was measured.

For calibration of the analyzer, a calibration curve was prepared by TC measurement of a glucose powder reagent (carbon concentration: 40 %).



Fig. 1 Lithium Ion Battery



Fig. 2 Lithium Cobalt Oxide

Table 1 Measurement Conditions

Analyzer	: TOC solid sample system (TOC-L _{CPH} TOC analyzer + SSM-5000A solid sample combustion unit)
Cell length	: Short cell
TC oxidation method	: Combustion catalytic oxidation (Combustion temperature: 900 °C)
Measurement item	: TC (Total carbon)
Calibration curve	: One point calibration curve by glucose powder reagent (Carbon concentration: 40 %)
Sample	: Lithium cobalt oxide (Lithium cobalt (III) oxide, LiCoO ₂) reagent
Additives	: 5 % addition, glucose powder; 1 % addition, 5 %C glucose solution; 0.2 % addition, 0.5 %C glucose solution

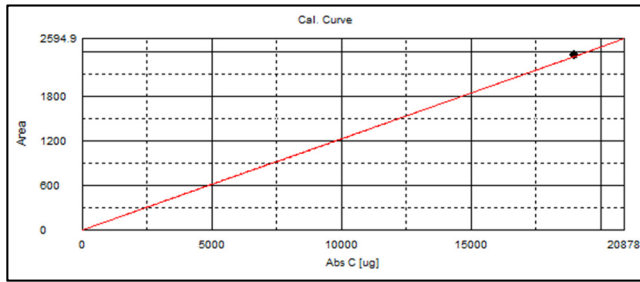
■ Analysis Results

Table 2 shows the results of measurements of the lithium cobalt oxide and the samples with the added carbonaceous substance. Fig. 3 shows the measurement charts. It can be understood that the samples with the added carbonaceous substance were measured with high accuracy.

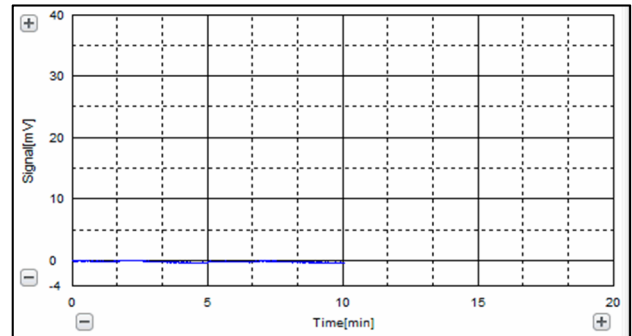
Table 2 Measurement Results

Sample	TC Measurement Value (%C)
Lithium Cobalt Oxide	0
Lithium Cobalt Oxide + 0.2 % Glucose	0.209
Lithium Cobalt Oxide + 1.0 % Glucose	0.999
Lithium Cobalt Oxide + 5.0 % Glucose	5.02

Analysis Data

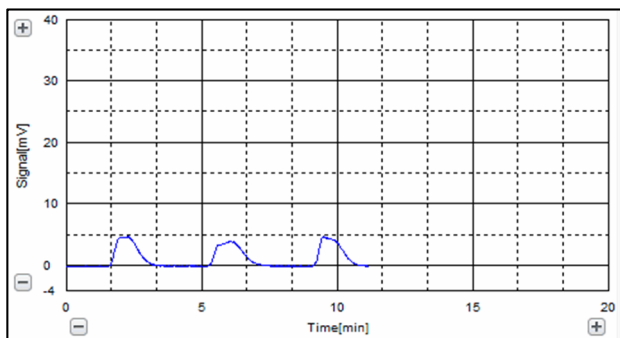


Calibration Curve



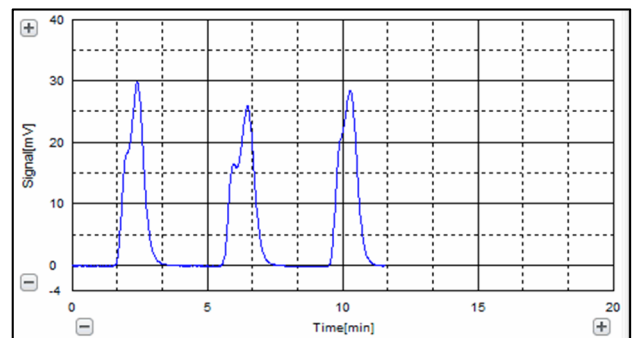
Inj. No.	Area	CNV	Abs C	Conc.	Result	Weight	CV Conc.
1	0.000	0.000	0.000	0.000	SSM-TC:0.000%	107.8	0.00
2	0.000	0.000	0.000	0.000		102.1	

Sample: Lithium Cobalt Oxide



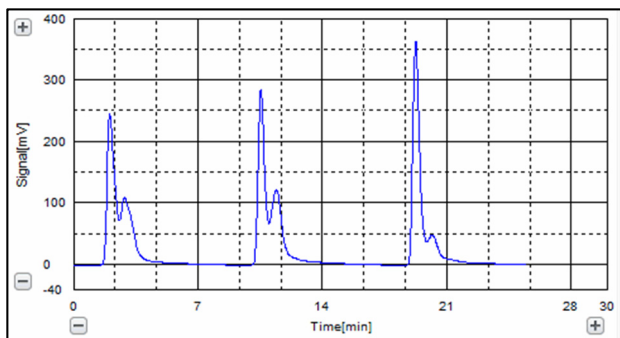
Inj. No.	Area	CNV	Abs C	Conc.	Result	Weight	CV Conc.
1	26.73	26.73	215.1	0.2102	SSM-TC:0.2088%	102.3	0.67
2	25.99	26.38	209.1	0.2075		100.8	
3	26.20	26.54	210.8	0.2087		101.0	

Sample: Lithium Cobalt Oxide + 0.2 % Glucose



Inj. No.	Area	CNV	Abs C	Conc.	Result	Weight	CV Conc.
1	129.7	129.7	1044	0.9835	SSM-TC:0.9986%	106.1	1.58
2	130.7	133.9	1052	1.015		103.6	
3	130.0	131.5	1046	0.9971		104.9	

Sample: Lithium Cobalt Oxide + 1.0 % Glucose



Inj. No.	Area	CNV	Abs C	Conc.	Result	Weight	CV Conc.
1	1314	1314	10572	5.006	SSM-TC:5.022%	211.2	0.34
2	1363	1323	10966	5.040		217.6	
3	1263	1318	10162	5.021		202.4	

Sample: Lithium Cobalt Oxide + 5.0 % Glucose

Fig. 3 Measurement Data

First Edition: Dec. 2018



For Research Use Only. Not for use in diagnostic procedures.

This publication may contain references to products that are not available in your country. Please contact us to check the availability of these products in your country.

The content of this publication shall not be reproduced, altered or sold for any commercial purpose without the written approval of Shimadzu. Shimadzu disclaims any proprietary interest in trademarks and trade names used in this publication other than its own. See <http://www.shimadzu.com/about/trademarks/index.html> for details.

The information contained herein is provided to you "as is" without warranty of any kind including without limitation warranties as to its accuracy or completeness. Shimadzu does not assume any responsibility or liability for any damage, whether direct or indirect, relating to the use of this publication. This publication is based upon the information available to Shimadzu on or before the date of publication, and subject to change without notice.

Shimadzu Corporation

www.shimadzu.com/an/