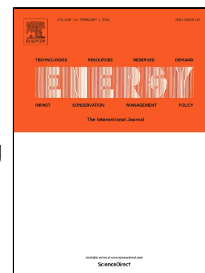


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Internal Resistance and Heat Generation of Soft package $\text{Li}_4\text{Ti}_5\text{O}_{12}$ Battery during Charge and Discharge

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Abstract: The resistance and heat generation of soft package $\text{Li}_4\text{Ti}_5\text{O}_{12}$ batteries in two different lifecycle (One was cycled 2100 times at 55 °C and swollen, the other is a new one) were studied in this paper. The ohmic resistance, polarization resistance and electrochemical impedance spectroscopy of these two cells were investigated. Accelerating rate calorimeter was used to study the generated heat at the C-rates of 0.5 C, 2 C and 5 C in charging and discharging processes. The amount of total generated heat, reversible and irreversible were obtained. The results showed that ohmic resistance of the swollen battery was higher than that of the new one, while polarization resistance tended to be smaller. The heat produced during discharge was greater than that by charge. In single charge or discharge process, the heat generation rate of the swollen battery was higher than that of the new one at all C-rates. The swollen battery released more reversible heat in charging process, especially at a lower state of charge.

Keywords: Lithium titanate; Lithium-ion battery; Swelling; Resistance; Heat generation

Nomenclature			
Abbreviations, description			
ARC	Accelerating Rate Calorimeter	R_p	The polarization resistance, Ω
CC	Constant Current	I	The working current, A
CHA	Charge	m	The mass of the battery, g
CPE	Constant Phase Element	η	The over potential, V
C-rate	Current rate	Δt	The time of charge or discharge, s
DCH	Discharge	T	The working temperature of the battery, K
DOC	Depth of Charge	ΔS	The entropy change of the reversible chemical reaction, $\text{J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$
DOD	Depth of Discharge	z	The number of electrons transferred by electrode reaction, mol
		F	The Faraday constant, $9648534 \text{ C}\cdot\text{mol}^{-1}$
		$\left(\frac{\partial E_{ocv}}{\partial T}\right)_p$	The entropy coefficient, $\text{V}\cdot\text{K}^{-1}$
EIS	Electrochemical Impedance Spectroscopy	ΔT	The adiabatic temperature rise, K
HPPC	Hybrid Pulse Power Characterization	$\frac{dT}{dt}$	The adiabatic temperature rise rate, $\text{K}\cdot\text{s}^{-1}$
LTO	$\text{Li}_4\text{Ti}_5\text{O}_{12}$	$R_{ohm-dic}$	The ohmic resistance during discharge, Ω

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