June 2019 Newsletter
Battery Applications

Latest developments at THT

The UK office has been extended with Sales & Marketing and R&D now occupying South House. Work on expanding and refurbishing the Production and Lab areas in North House is now underway.

.

Our production team continues to grow with Rory Sadler and Collins Oti joining the mechanical team as Assembly Technicians.

Rory Sadler

Collins Oti

China User Meeting

THT were back in Beijing to join our Chinese team for our annual battery user meeting. The conference included presentations from THT and ARC users and attached over 50 attendees including prospects and new users, signalling the continued growth of the Chinese market.

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ARC

Advanced Battery Power Conference

The Advanced Battery Power conference took place April 3-9 in Aachen/Germany. THT exhibited at the show alongside our Germany distributors C3 distributors. The conference was well attended by both research institutes, universities and companies. Alastair Hales from Imperial College was invited to give a short presentation giving an overview of the ICP we have been collaborating on as part of the Faraday Program.

ECS, Dallas

THT were proud sponsors of a special session on advanced calorimetric techniques for investigating LIB safety. Abstracts of the presentations can be found [online].

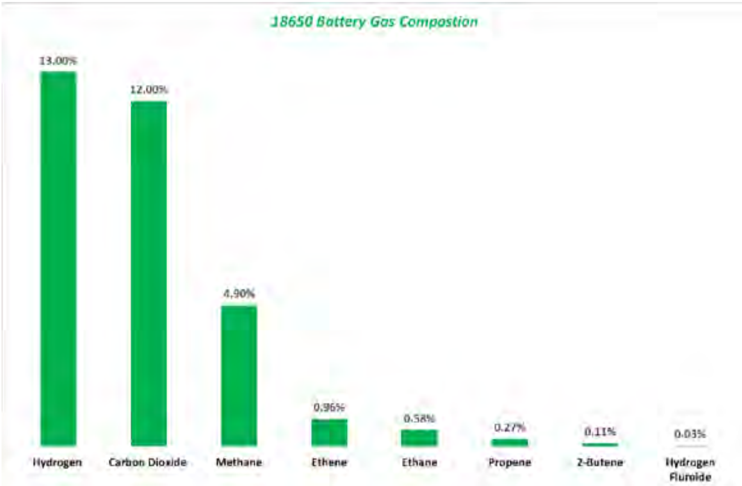
Gas Collection

THT offer 3 methods for collecting gas samples from an ARC test. These range from a passive arrangement utilising a non-return valve and collection cylinder to software controlled systems based on specific time, temperature and pressure rates.

SSM Sample System Manual for gas collection after test to 50ml cylinder.

SSS Single Sampling System, software controlled for collection of gas after the test .Or at a specified time prior to the end of the test to 50ml cylinder.

SSU System Sampling Unit provides 4 sampling cylinders (3x 10ml; 1x 25ml). Collection is software triggered on basis of either temperature, pressure, time, temperature change, pressure change or onset of exotherm.



Typical gas sample analysis from a commercial 18650 cell ($LiNiCoAlO_2$ cathode)

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ARC

Gas Collection Options

SSM: Manually operated system

SSS: Single sample system based on time or temperature

SSU: Upto 4 independent samples collected based on t, T, dT/dt, P, dP/dt

Download our new ARC brochure

The latest brochure features the ES, EV and EV+ ARC systems, helping customers select the appropriate calorimeters and options for their needs. Copies can be requested via the sales office; a PDF version is also available for download.

Latest papers

Since our last newsletter several papers have been released citing use of the THT ARC. Publications come from institutes located in China, Germany, France and UK with contributions from Tsinghua University, TUM, CEA and University of Sheffield.

A full list of abstracts and links to purchase can be downloaded here.

THT

THERMAL HAZARD TECHNOLOGY

HEAD OFFICE | US OFFICE | INDIA OFFICE

Papers citing use of THT ARC

Battery Papers

2019

Journal of Power Sources 414 (2019) 557-568

Pursuing safer batteries: Thermal abuse of LiFePO4 cells

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Abstract

In this paper, accelerated rate calorimetry (ARC) and oven exposure, are used to investigate thermal runaway (TR) in lithium-ion cells. Previous work shows that lithium iron phosphate (LFP) cells have a lower risk of TR over other Li-ion chemistries. ARC is carried out on cells at various SOC to identify which decomposition reactions are contributing to the TR behaviour of a cell at different SOC. Results show, at SOC of 100% and 110%, the negative and positive electrode reactions are the main contributors to TR, while at lower SOC it is the negative electrode reaction that dominates. Cells at 100% SOC exposed to high temperatures during oven tests show, along with the ARC analysis, that the presence of the cathode and electrolyte reactions leads to an increase in the severity of a TR event for oven temperatures above 200 C. By comparing the heat generated in ARC and oven testing, it is shown that ARC does not fully capture the self-heating and TR safety hazard of a cell, unlike oven testing. This work gives new insight into the nature of the decomposition reactions and also provides an essential data set useful for model validation which is of importance to those studying LFP cells computationally.

Link to purchase paper: https://www.sciencedirect.com/science/article/pii/S037877531930014X

Energy Procedia 158 (2019) 4684-4689

Key Characteristics for Thermal Runaway of Li-ion Batteries

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Abstract

The lithium ion batteries are having increasing energy densities, meeting the requirement from industry, especially for the electric vehicles. However, a cell with a higher energy density is more prone to thermal runaway. We analyze the key characteristics during thermal runaway to help better define battery thermal runaway. Three characteristic temperatures are regarded as the common features of thermal runaway for all kinds of lithium ion batteries. The underlying mechanisms for the three characteristic temperatures have been investigated by thermal analysis. The conclusion of the analysis set benchmarks for evaluating the thermal runaway behaviors of commercial lithium-ion batteries, and the proposed methodologies benefits further research and development of battery safety design for electric vehicles.

Link to purchase paper: https://www.sciencedirect.com/science/article/pii/S187661021930774X

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ICP

Isothermal Control Platform

THT have been working with Imperial College to develop an Isothermal Control Platform (ICP). The platform will offer precise regulation of battery temperatures using multiple zone control.

Performance of lithium-ion (Li-Ion) cells is known to be strongly dependent on temperature. Poor thermal control during cell characterisation tests can lead to misleading battery characterisation and modelling. Cell models using data from non-isothermal experimental conditions will output incorrect data. Consequently, these errors influence the design of battery packs and battery management systems (BMS) in a manner which can reduce lifetime, performance and safety. This is of particular importance to the automotive industry, where optimal use of lithium-ion cells at high rates of charge and discharge, and a range of temperatures is paramount.

Environmental chambers based on air convection are the industry standard thermal control method used in cell characterisation. However, thermal control through air convection alone is not sufficient during vigorous cell cycling. In an environmental chamber, the cell temperature will rise significantly during cell charge/discharge and drive cycle testing. This is a particular problem for high C rate testing. Not only will this lead to poor data being gathered, but some test regimes will not be possible as the temperature would become dangerously high and lead to thermal runaway.

Further ambiguity is caused by heat loss through the cell tabs / terminals, and the electrical connections to these. Significant heat can be lost (or gained) via this route, but the cell tabs / connections are generally not controlled in an environmental chamber.

The ICP uses specially designed peltier element modules in direct contact with the cell surface and/or tab connections to closely control and monitor temperature. This leads to a system which is highly thermally stable.

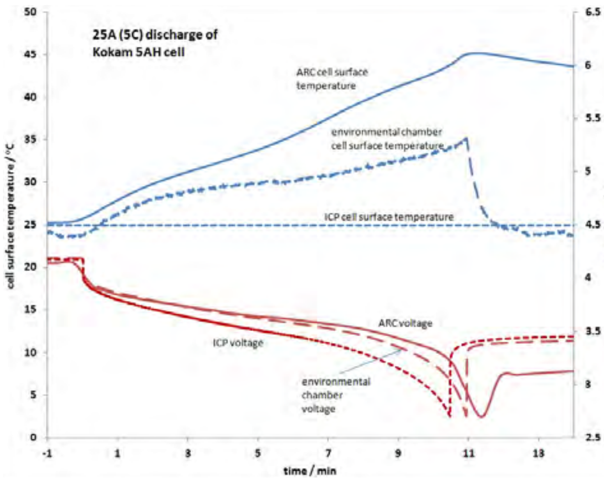


Fig.1 above compares cell surface temperature and voltage characteristic of a 5Ah Kokam NMC cell during a 5C (25A) constant current discharge. Discharge tests were performed in a standard environmental chamber, in a THT ARC (near-adiabatic conditions) and the ICP.

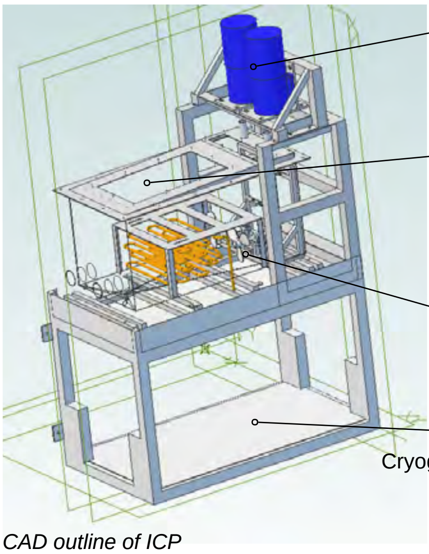
It can be seen that there is a significant temperature rise (~10°C) during the discharge in the environmental chamber - about half of the temperature rise observed for the adiabatic case, whereas the ICP holds the temperature to well within +/- 0.1°C of the setpoint.

The cell voltage curve derived from the environmental chamber deviates greatly from that found in the ICP (the 'true' isothermal case). This is due to the significant effect that cell temperature has on cell performance.

In fact, the environmental chamber data is in some ways closer to the adiabatic case than the 'isothermal' case. Thus the ICP will provide much more accurate and usable data for cell modelling and characterisation.

Register your interest to receive further updates on the ICP Isothermal Control Platform

ICP



CAD outline of ICP

ICP Specification

- Accommodates cylindrical, prismatic and pouch cells
- Sample size (pouch cell) up to 30 x 20 x 3cm plus tabs
- Temperature range -20°C to +70°C
- 10°C step change within 5 min with 5 min settling time
- Temperature control + 0.2°C across sample
- Heat dissipation up to 0.5W/cm^2 for each surface (1W/cm^2 max capacity)
- Cell internal temperature predicted 'live' during test by Imperial College heat transfer model.

Exhibitions

During 2019 THT will be exhibiting at the following events.

3-5 September
Cenex-LCV
Millbrook, UK

10-12 September
Battery Show 2019
Novi, USA

16-18 October
Inter Battery
Soul, Korea

22-24 October
Batteries Event 2019
Nice, France

22-25 October
Battery Safety Summit
Alexandria, USA

28-31 October
AABC, Asia
Tokyo, Japan

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