European Automobile Manufacturers Association

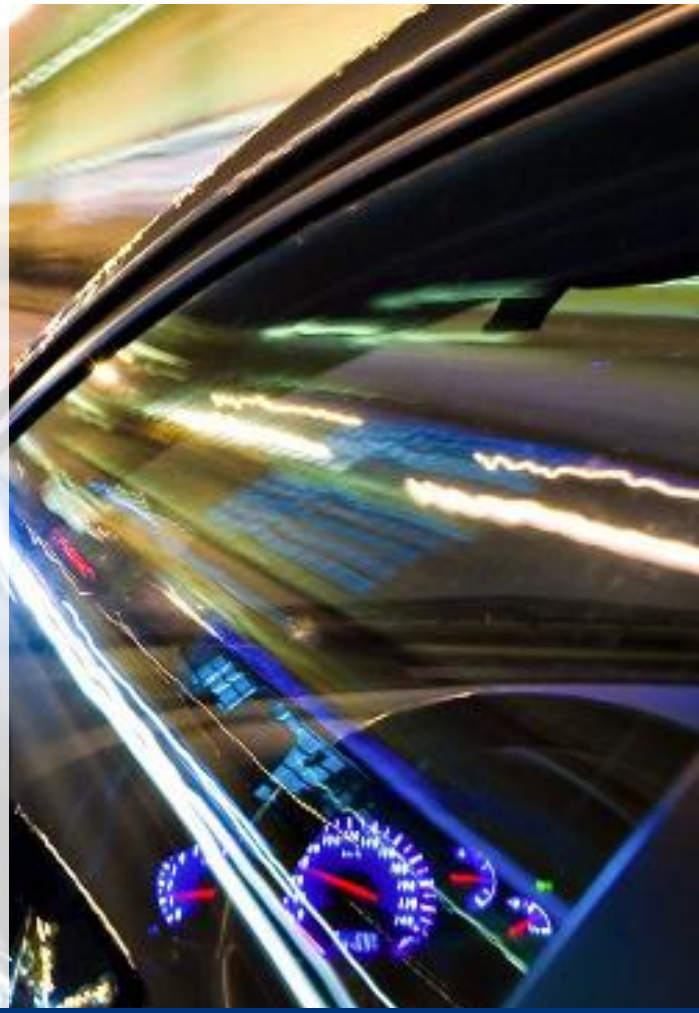
ACEA

Ultrasonic heating as a non-invasive trigger method for thermal runaway

A feasibility prestudy

UN IWG EVS GTR

DETROIT, 23-24 JANUARY 2019



A study performed by HORIBA-MIRA on behalf of ACEA TF-EVS

A summary prepared by Annika Ahlberg Tidblad and Alexander Börger

OUTLINE

- Objective
- Technical background
- Results
- Conclusions

OBJECTIVE

- **The thermal runaway initiation methods studied so far by IWG EVS GTR suffer from critical shortcomings:**
  - Lack of basic repeatability and reproducibility required for regulation
  - Questionable representativeness of test results since s ignificant modifications of the REESS/battery are necessary for the purpose of test, and these may have adverse effects on the test results
    - **Disassembly of casing and structural components**
    - **By-passing/disabling of safety devices/features**
  - Unrepresentative acceleration of thermal runaway parameters/added energy creating unrepresentative conditions in the battery
- **ACEA wants to support test method development by evaluating alternative non-invasive thermal runaway trigger methods.**
- **A feasibility study of ultrasonic heating as a candidate method was commissioned to Horiba-MIRA, with technical support from experts at The Warwick University.**

TECHNICAL BACKGROUND

- **Ultrasound refer to travelling pressure or stress waves, generally above the human hearing threshold 20 kHz, and carry energy in the form of particle displacement**
- **Ultrasonic waves can be converted to heat by absorption into a material**
- **Most man-made ultrasonic sources use piezoelectronics**
  - Piezoelectric materials deform when a voltage is applied
- **To focus an ultrasonic beam with sufficient power to initiate thermal runaway**
  - The frequency should be as high as possible
  - The source must be as large as possible
  - The focal point should be as close to the source as possible

RESULTS

- **Ultrasonic waves can be generated from a single source with powers up to 3kW, enough to cause significant heating within materials**
- **Focussing methods can be used to target a particular zone to be "excited"**
- **Ultrasonic waves propagate through materials but reflect, reflact and diffract at material interfaces, especially at air-gaps**
  - Heating a single cell is not feasible without compromising the battery casing
  - Large and complex equipment are required

CONCLUSIONS

- **The recommendations of this study is that ultrasonic heating should not be considered further as a viable generic trigger method for thermal runaway in electric vehicle battery packs**
- **It is very challenging to find a candidate method which is truly non-invasive**

THANK YOU FOR YOUR ATTENTION

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