Assessment of the influence of product life on the mechanical behaviour of lithium-based traction batteries

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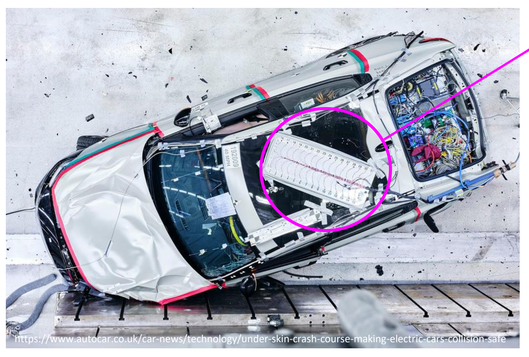
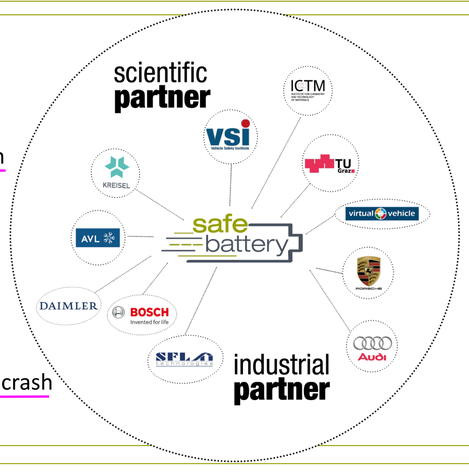
FFG Austrian Research Promotion Agency
bmvit Federal Ministry for Transport, Innovation and Technology
bmwfw Federal Ministry of Science, Research and Economy
Das Land Steiermark

Motivation



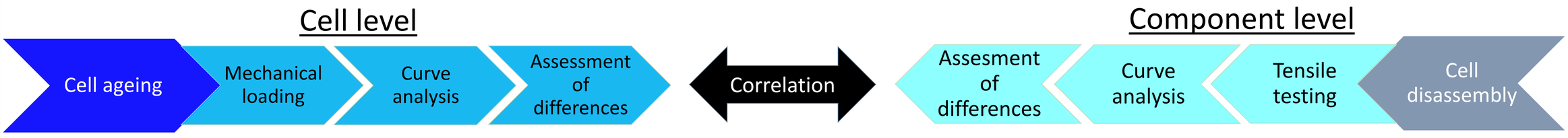
- Understanding battery degradation
- Increase electric vehicle SAFETY
- Decrease hazard risk
- Understanding battery behavior in crash



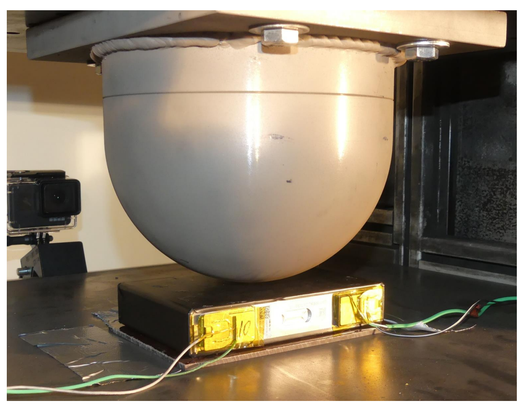
Research questions

- Is there any difference in the mechanical behavior of aged cells under:
  - Quasistatic mechanical crush load
  - Highly dynamic crash load
- Does cell ageing influence the tensile properties of the internal components?
- What effects influence the mechanical behavior of LIBS?

Method

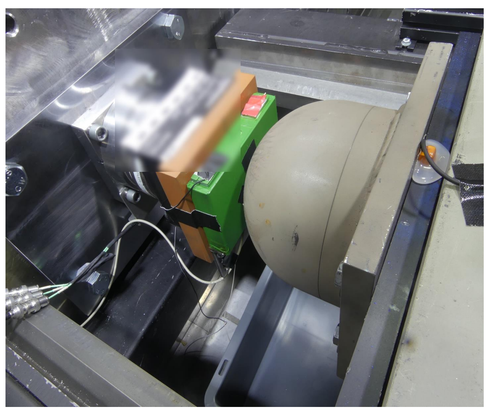


- Cell ageing:
  - High temperature operation endurance (HTOE)
  - Powered thermal cycle endurance (PTCE)
- Dynamic vs quasistatic loading:
  - 0% cell SOC
  - Hemispherical impactor shape
  - 3000mm/s vs 1mm/s
  - Fresh vs PTCE vs HTOE
- Cell disassembly
  - Opening of cell
  - Visual inspection of internal components
  - SEM cross-section analysis
  - Tensile testing
    - Assessment of difference on component level



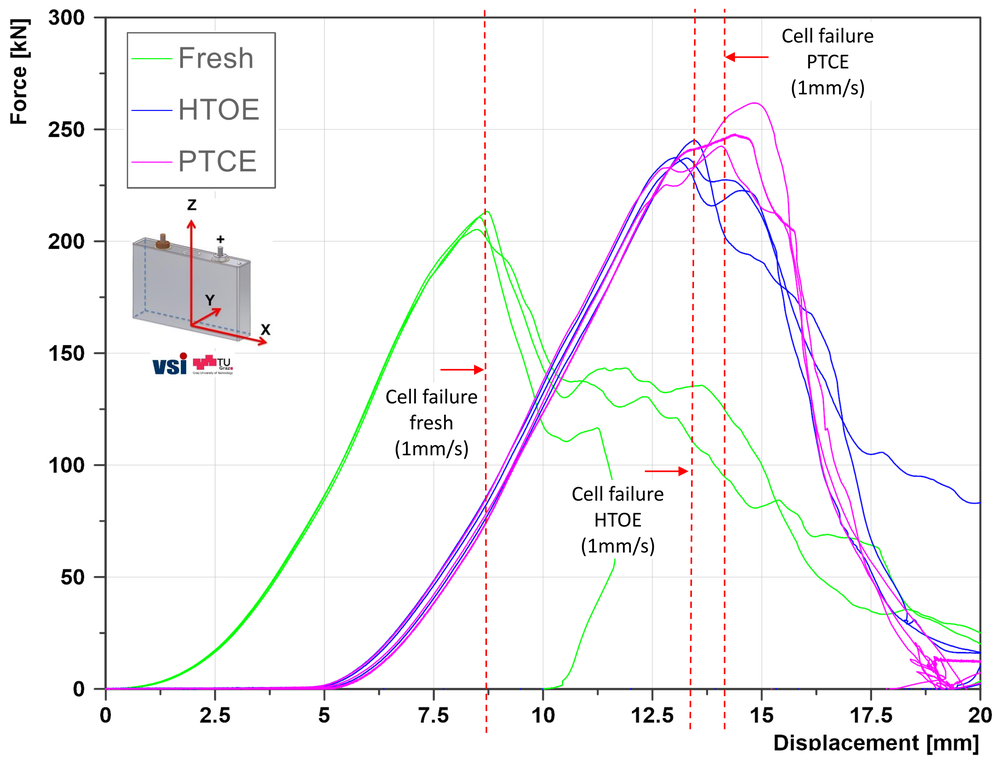
Quasistatic crush test

Vs

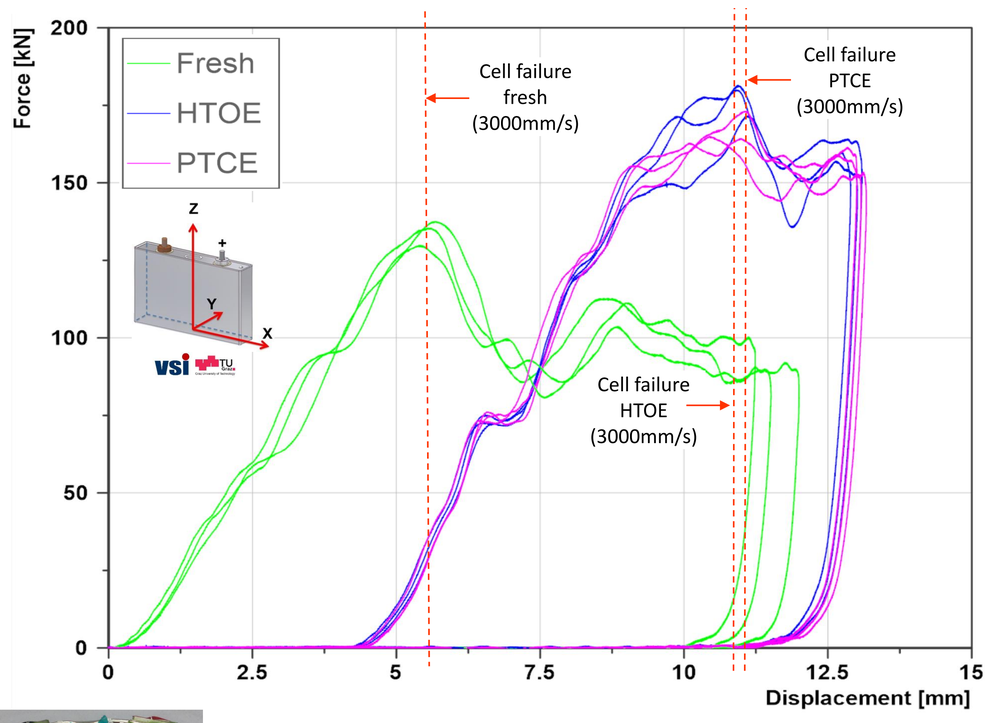


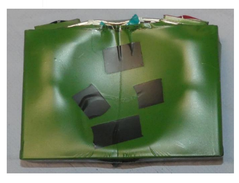
Highly dynamic crash test

Quasistatic crush test



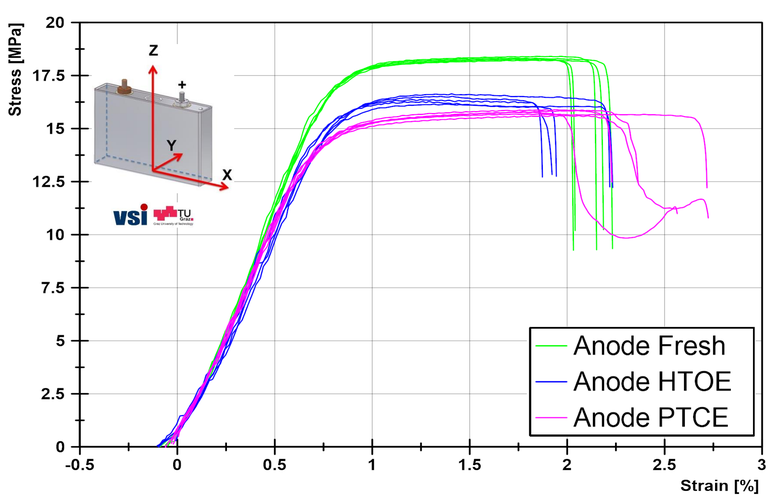
Highly dynamic crash test

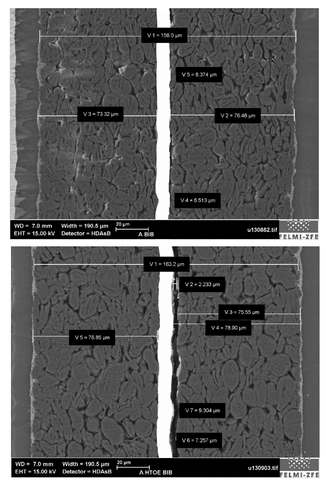


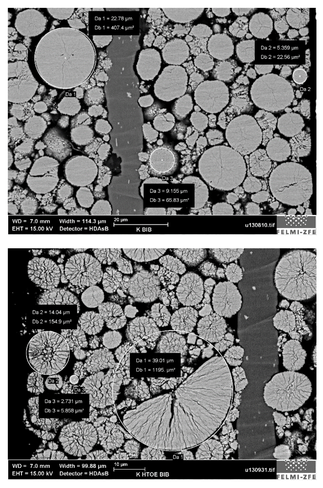


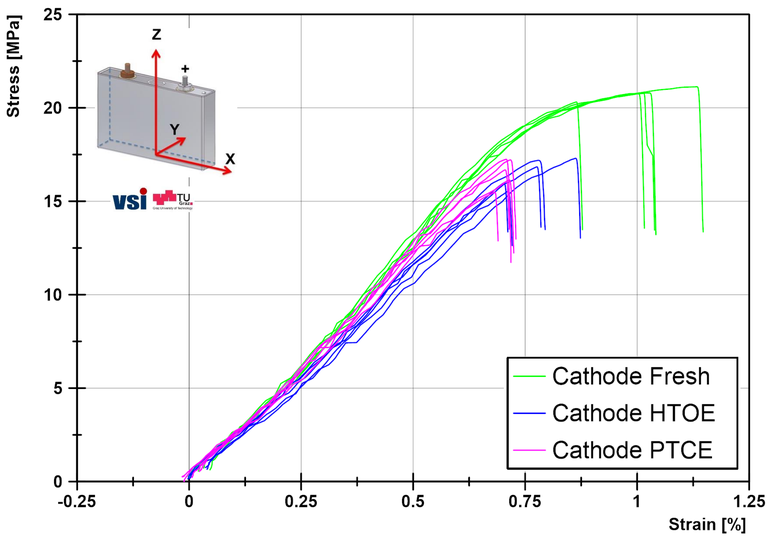
- Test highlights:
  - Failure at higher deformation/force
  - Cell failure dependent on cell thickness (gas generation → cell bloating)
  - Higher velocities more critical

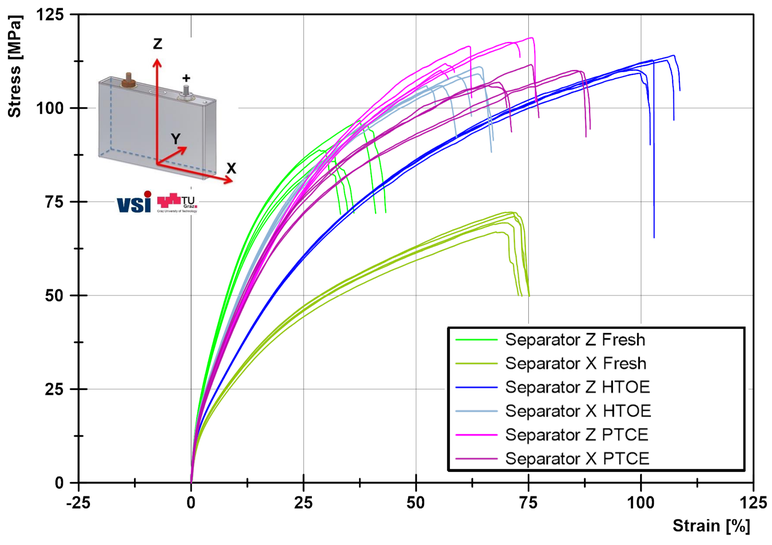
Tensile test











- Tensile test highlights:
  - Decrease of tensile strength of anode and cathode (particle cracks)
  - Increase in tensile strength of separator
  - Reduction of separator anysotropy

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