

# Multifunctional Structural Battery Composites: Integrating Energy Storage into Load-Bearing Aerospace Structures

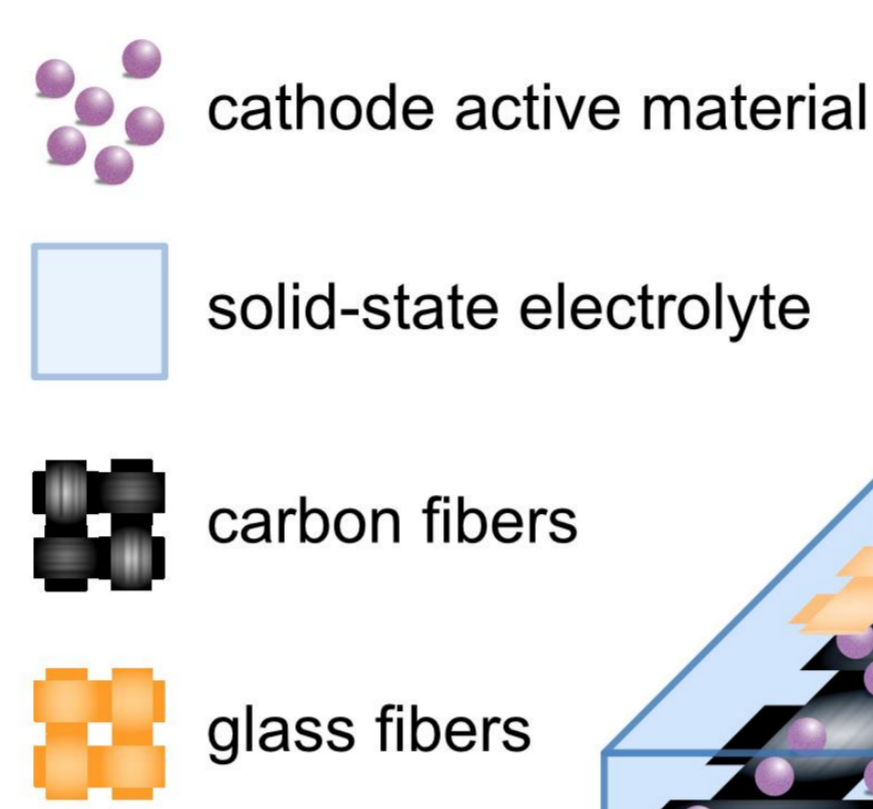
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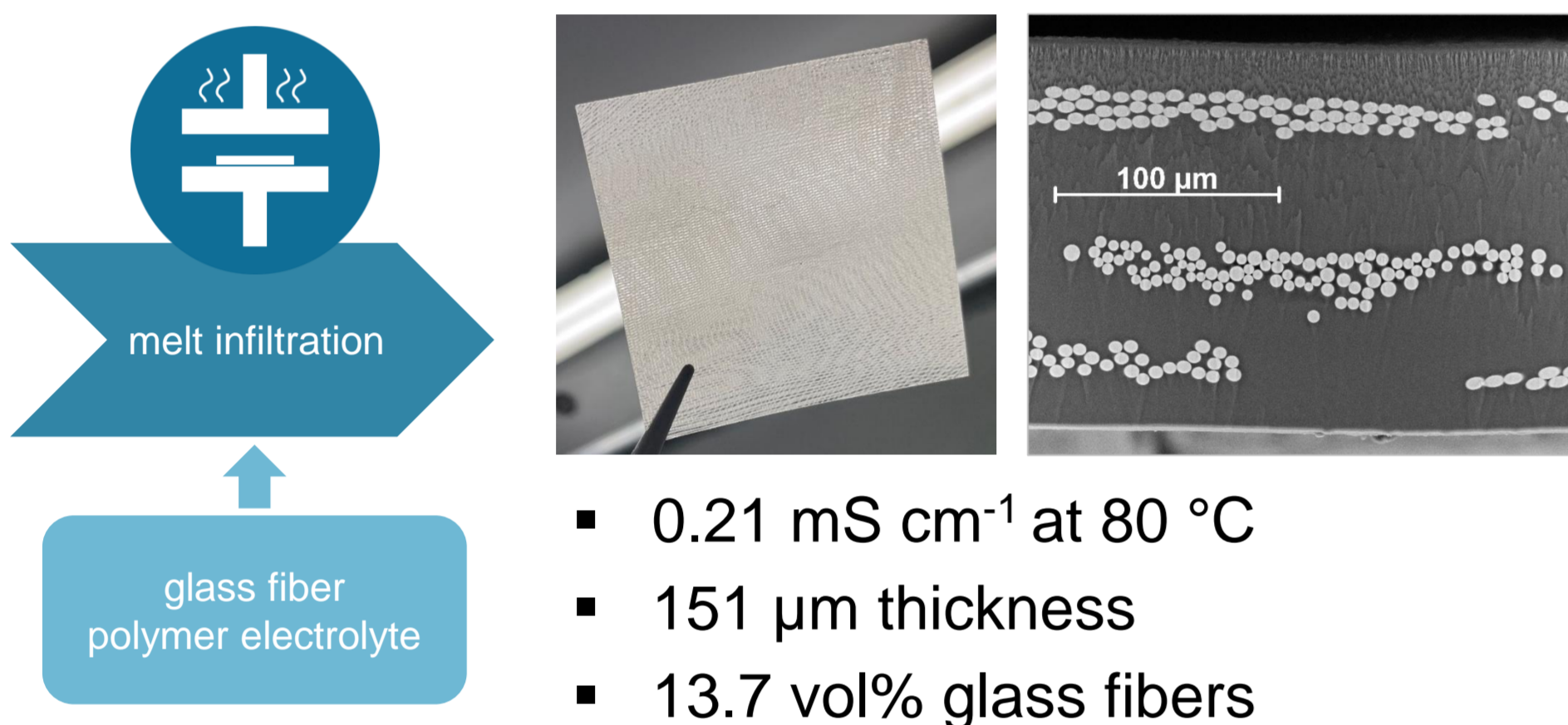
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## Objective

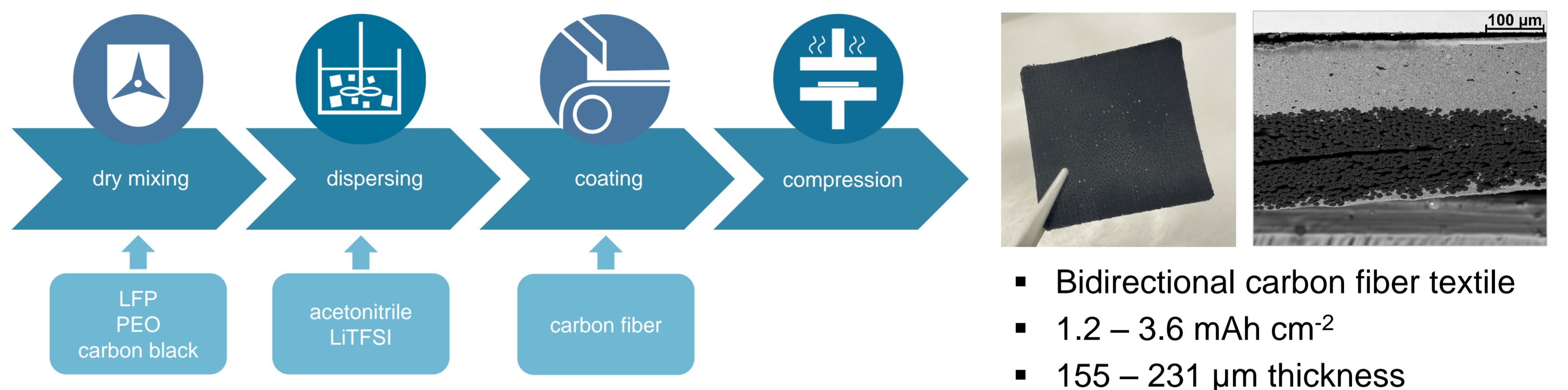
- State-of-the-art battery technologies cannot fulfill the specific energy requirements for the commercial air transport sector
- Multifunctional structures and materials:
  - Structural battery composites can store electrical energy while also bearing mechanical loads
  - Reduction of parasitic mass and volume



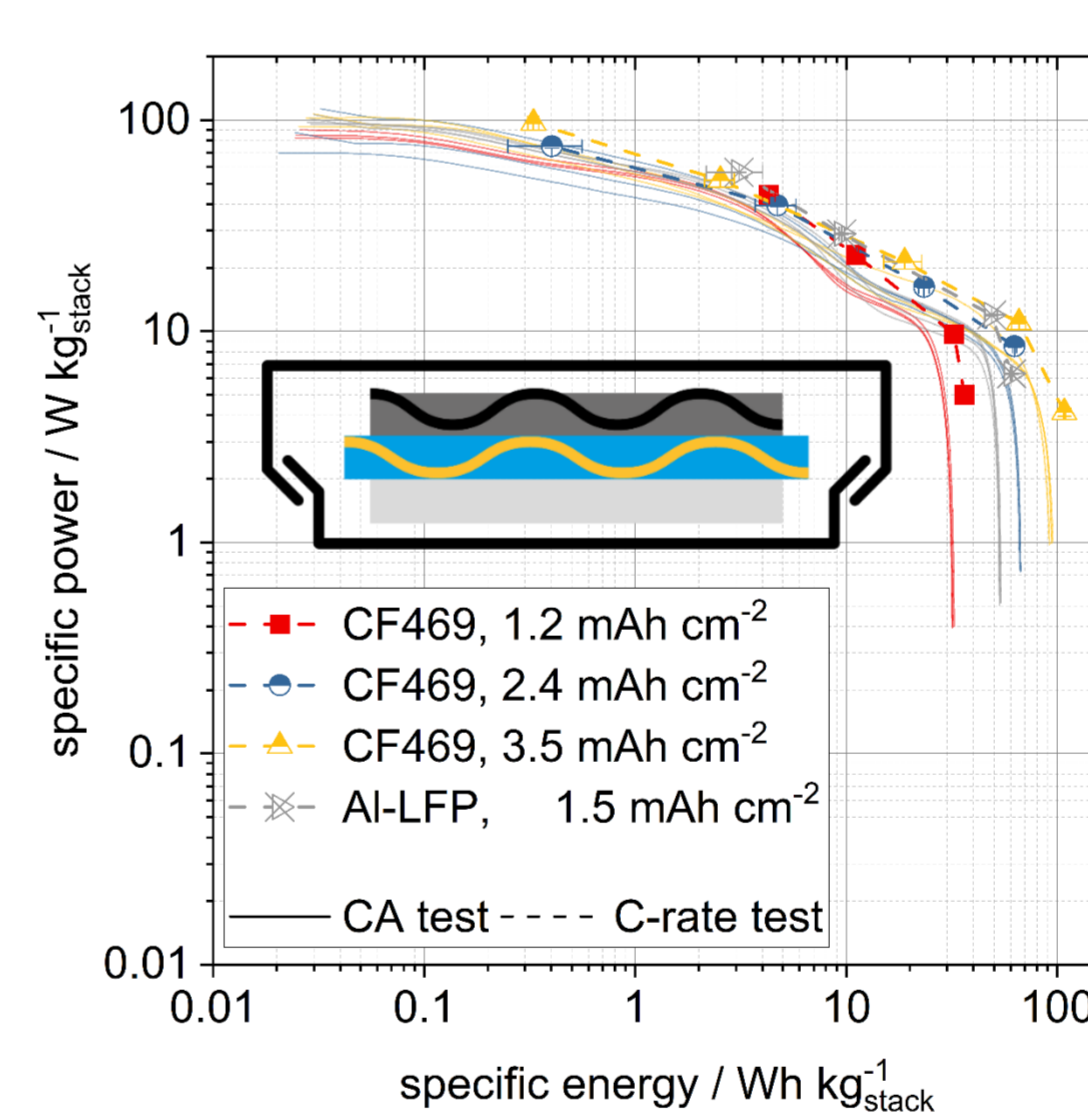
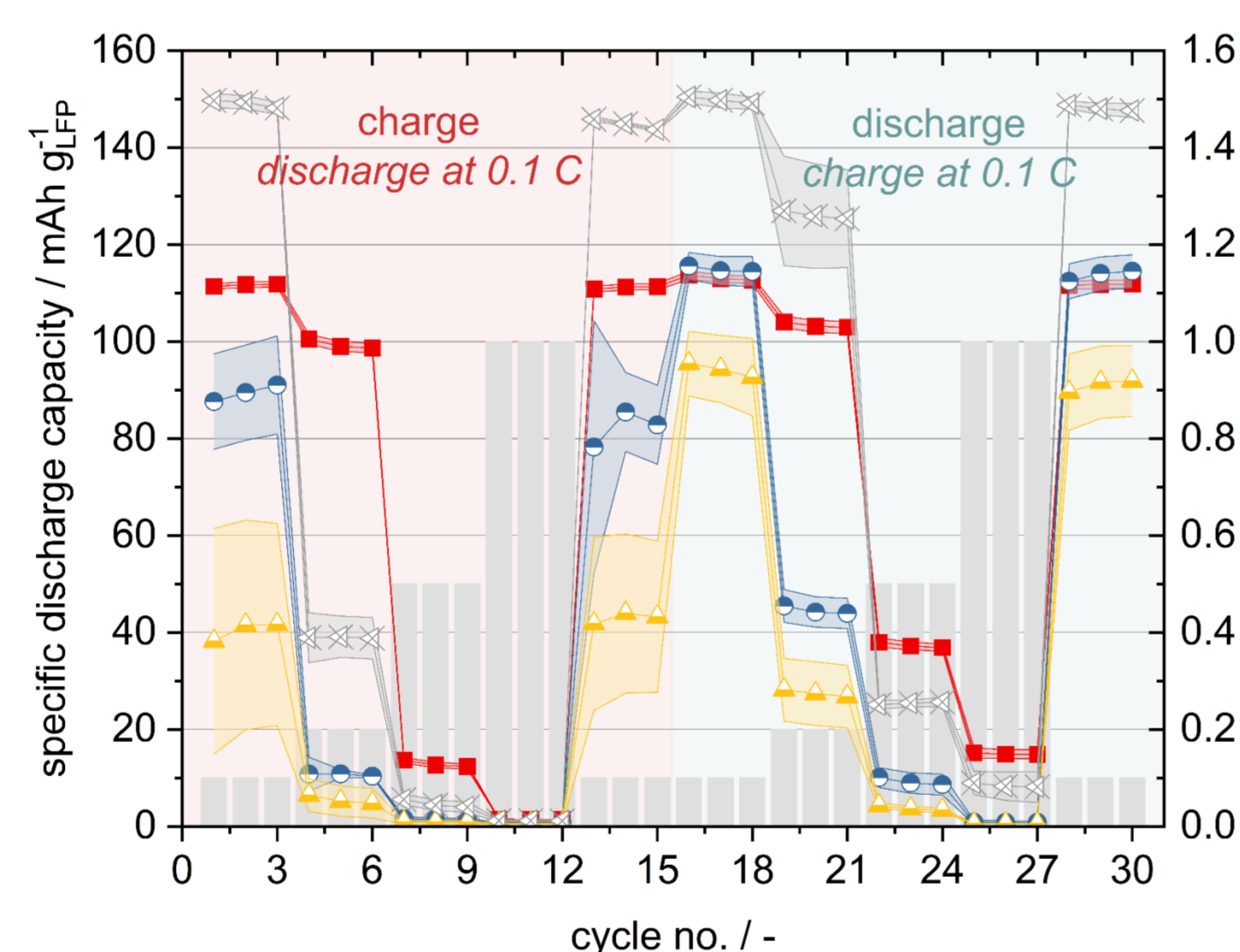
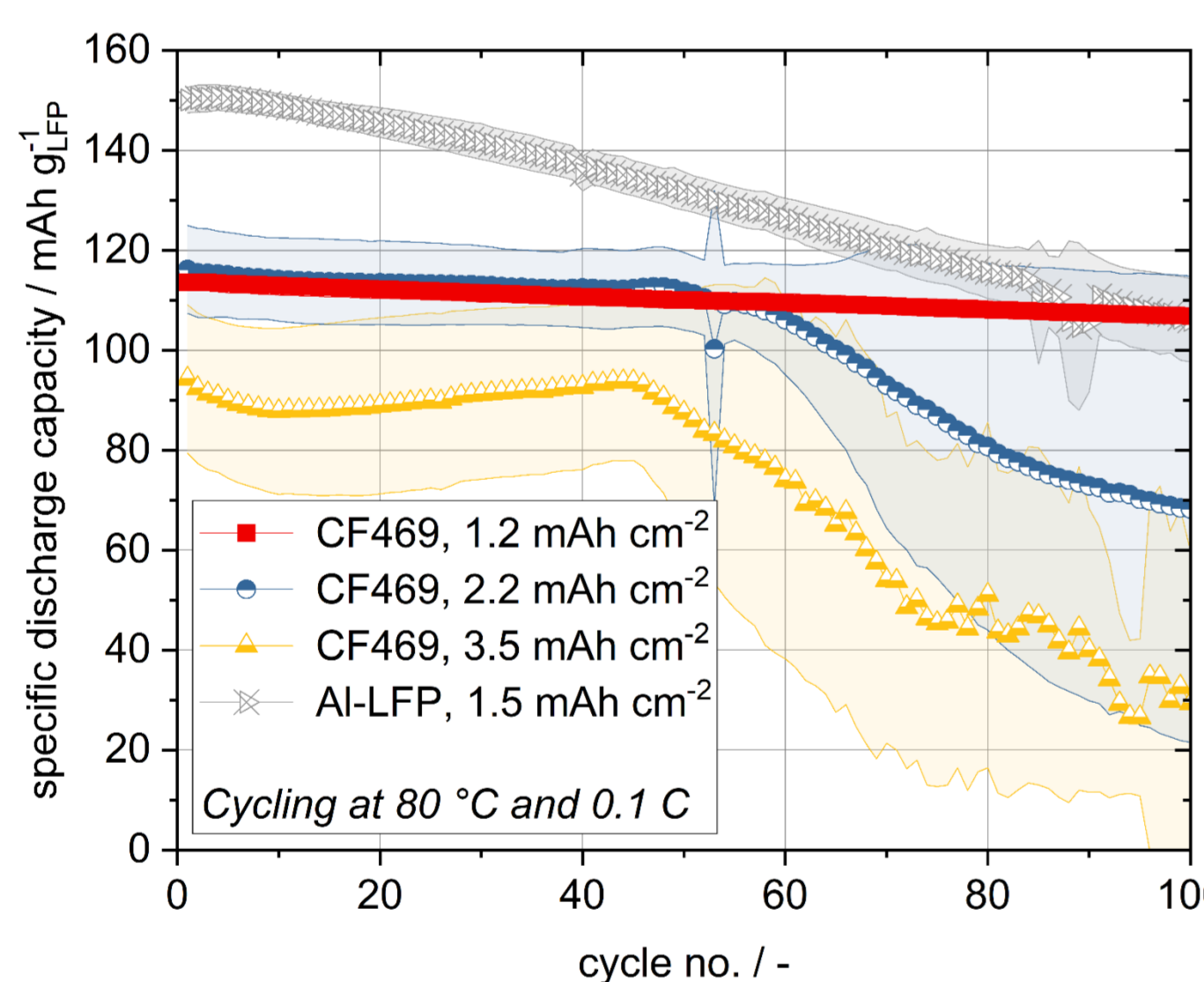
## Structural Separators



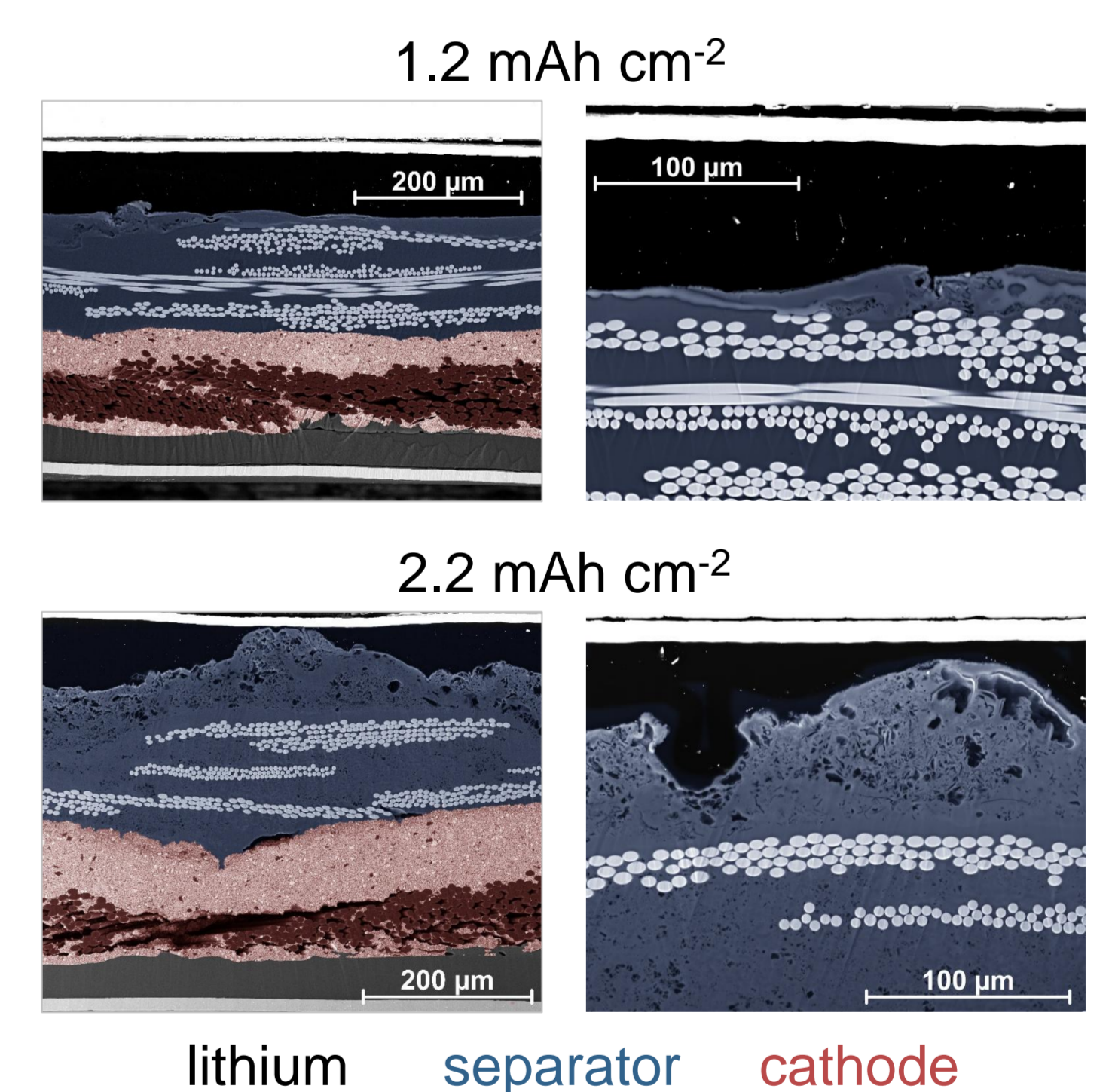
## Structural Cathodes



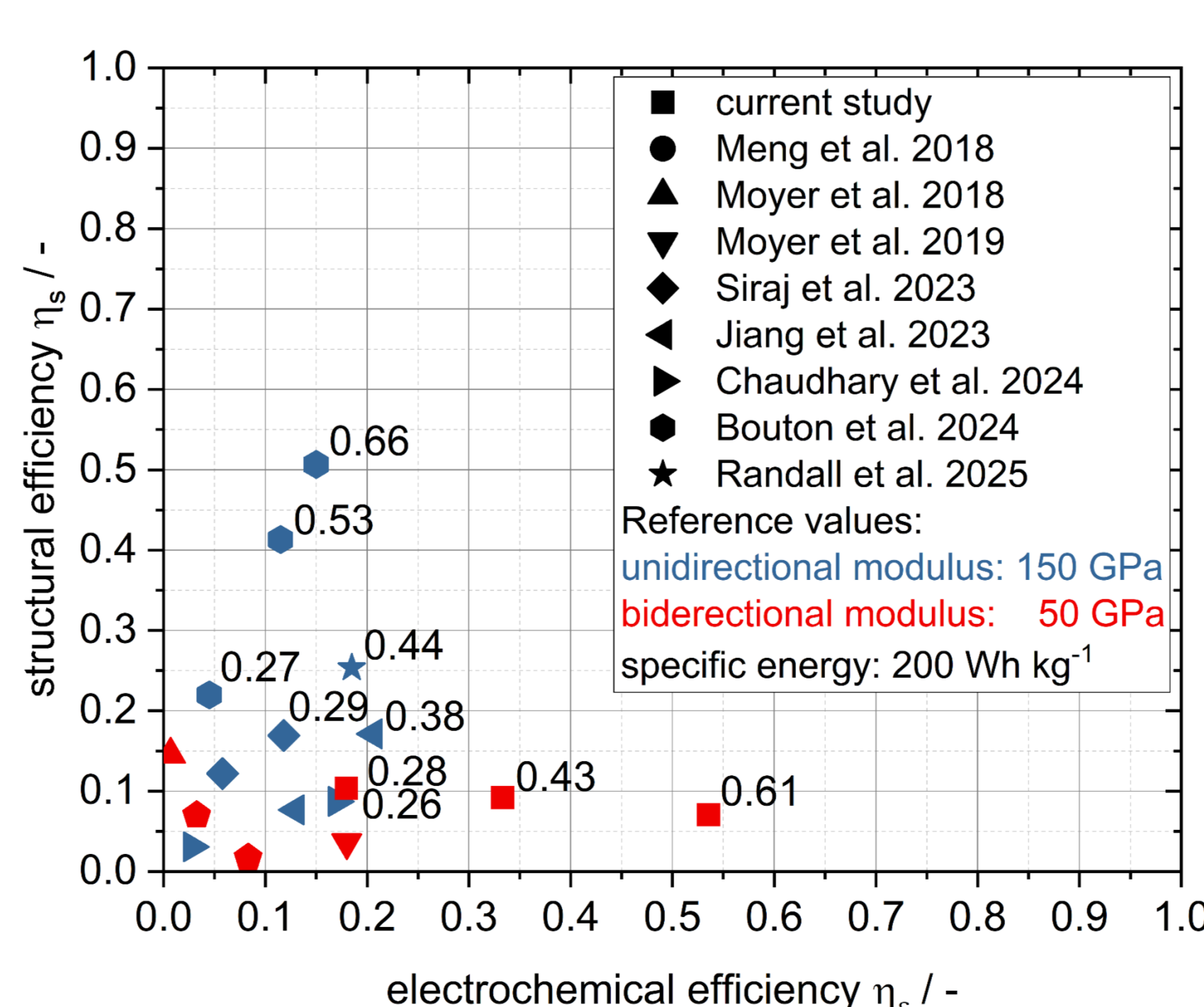
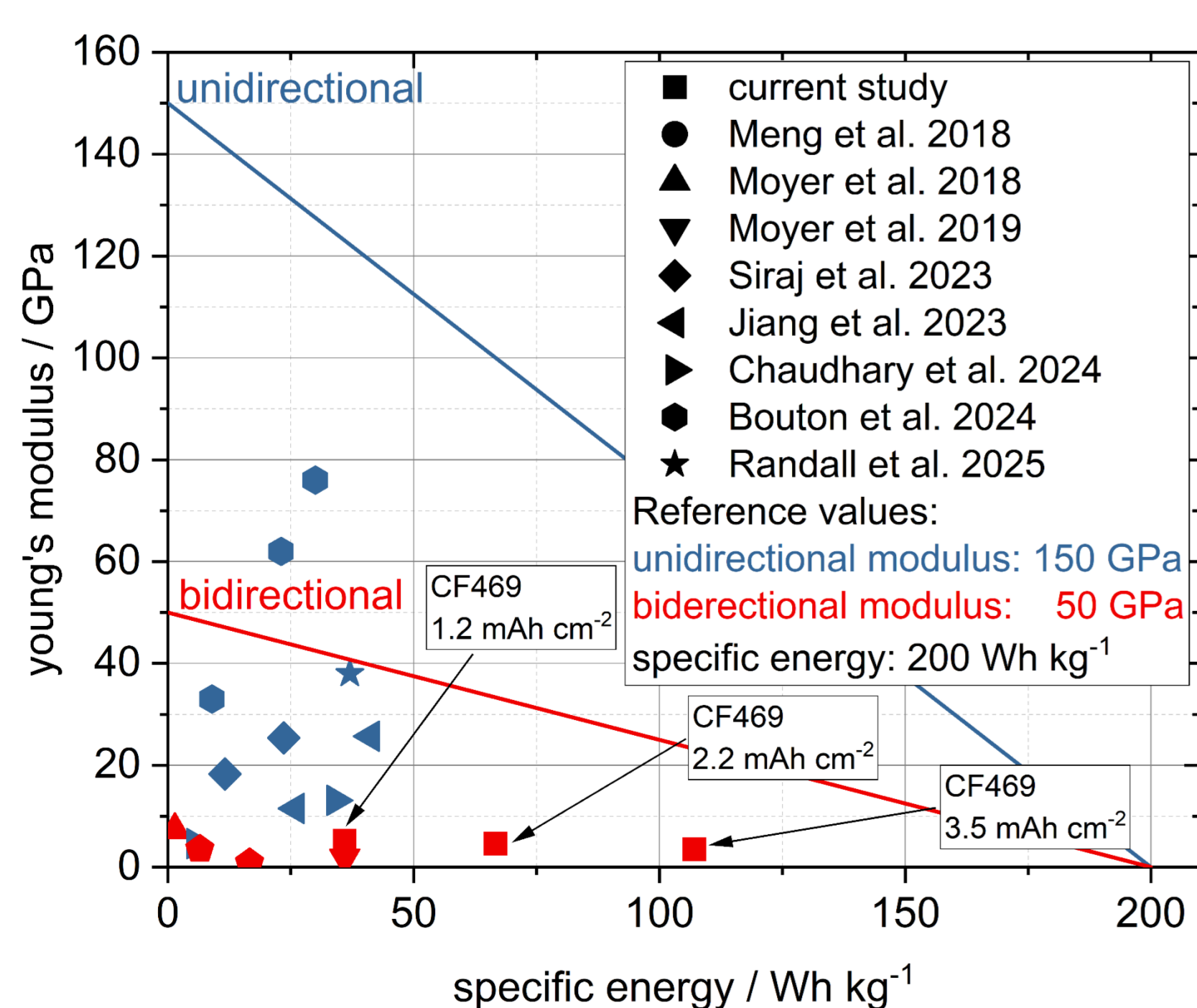
## Electrochemical, Mechanical and Multifunctional Performance



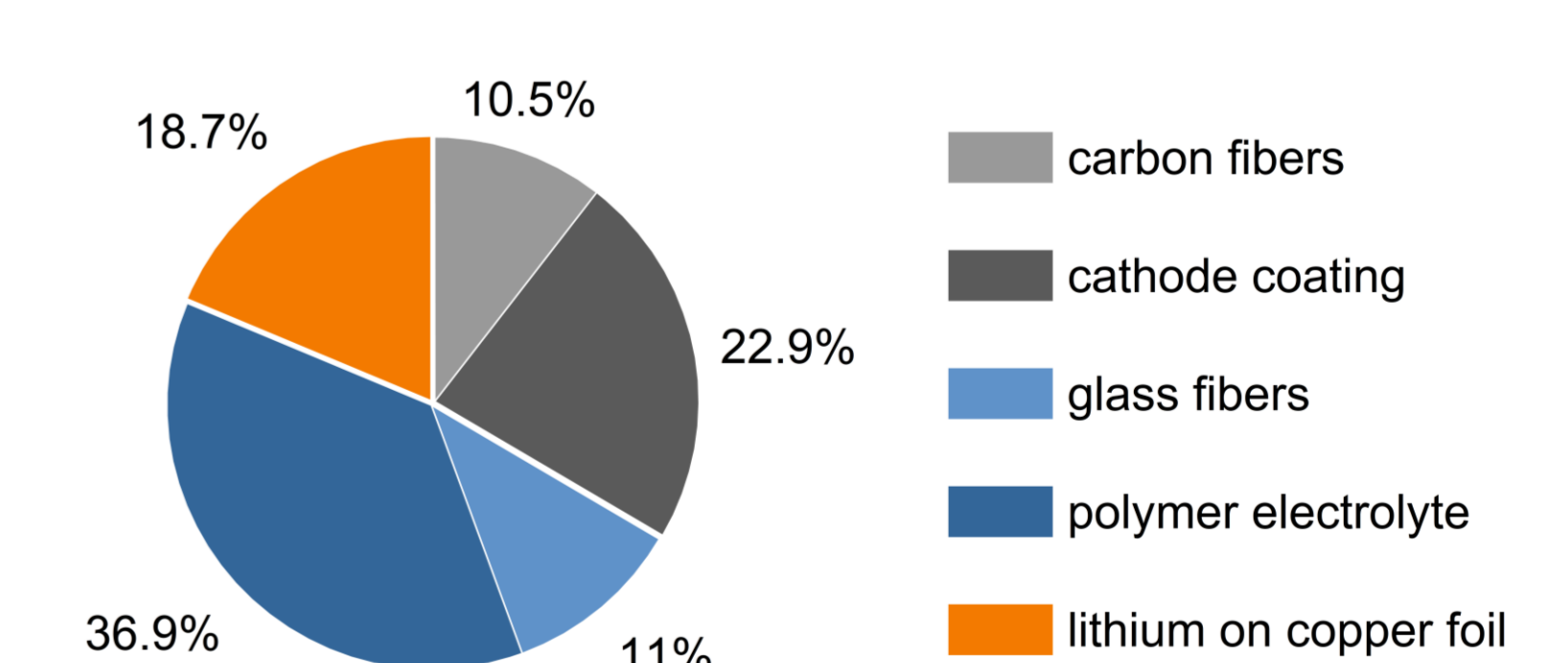
post mortem cross-sectional cuts



- Very stable cycling performance is achieved at low areal loadings
- Higher areal loadings enable higher specific energies, however stronger capacity fading is observed
- Fading at higher areal loadings is caused by the formation of „mossy“ and dendritic lithium
- A fraction of the coated active material is lost in the carbon fibers and cannot be utilized



Mass breakdown of CF469 at 2.2 mAh cm<sup>-2</sup>



- Superior electrochemical performance; mechanical performance not comparable to unidirectional designs
- Specific energy increases with areal loading, but Young's modulus decreases
- Reduction of separator weight and thickness can significantly improve performance
  - Advanced structural electrolytes

## Acknowledgements



SE<sup>2</sup>A

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