THE EFFECT OF STRESS-ASSISTED CONVECTION ON THE ELECTRO-CHEMO-MECHANICAL PERFORMANCE OF STRUCTURAL BATTERIES

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ABSTRACT

The so-called structural battery is a multifunctional material made from carbon fibre reinforced polymer (Figure 1a). This material has the ability to store electrical energy (i.e. work as a battery) and carry mechanical loads, simultaneously. In this material, the carbon fibres can function as combined active electrode material, current collector, and mechanical reinforcement. The fibres are embedded in a Structural battery electrolyte (SBE) [1] which consists of two phases: a solid phase (porous polymer network) and a liquid phase (liquid electrolyte with Li-salt). Hence, the liquid phase in the porous polymer network enables ion transport between the electrodes, while the solid phase makes it possible to distribute mechanical loads.

In this work, we will present and demonstrate the capabilities of a recently developed computational modelling framework [2, 3] for evaluating the coupled electro-chemo-mechanical properties of structural batteries (Figure 1b). In particular, we will focus on the contribution from the stress-assisted convection in the SBE (i.e. seepage of the liquid phase) and the influence of the SBE porosity on the combined electrochemical and mechanical performance. Finally, we will discuss the expected significance of these effects in the case of damage initiation and propagation.

REFERENCES

[3] D. Carlstedt et al., Computational modelling of structural batteries accounting for stress-assisted convection in the electrolytes, Accepted for publication in International Journal of Solids and Structure