**Computer simulations of two-phase cooling systems for electric vehicle battery packs**

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**Abstract**

This study aims to explore immersion cooling battery thermal management systems (BTMS) for electric vehicles using simulations of submerged cooling and pool boiling, which offer higher heat transfer coefficients than single-phase forced convection. To achieve this goal, non-toxic and non-flammable dielectric fluids with boiling temperatures below 40°C, such as Novec7000, will be investigated as potential coolants for Li-ion batteries in computational fluid dynamics (CFD) simulations, to ensure proper temperature levels and uniform temperature distribution. The numerical methodology is relevant to different boiling regimes that are plausible to emerge in BTMS for EV battery packs. CFD simulations will be coupled with electrochemical/thermal models to replicate battery cell operation and consider the transient temperature field due to the battery's non-uniform heat generation rate. Additionally, non-Newtonian fluid effects will be implemented in the CFD solver to elucidate the influence of viscoelastic agents and surfactants on coherent vortical motion, bubble dynamics, and boiling heat transfer. The influence of non-Newtonian behaviour will be investigated through the implementation of additional elastic stress components in the momentum conservation equation governing fluid motion, to account for viscoelasticity-inducing agents, as well as variable surface-tension models to consider surface active agents. Preliminary simulations refer to 3D cases of battery cooling, utilising air, thermal oils, and NOVEC7000 as cooling media. Lithium-ion cells are treated as either simple heat-source terms or replicated through actual discharge curves of commercial lithium ferrophosphate (LFP) cells.