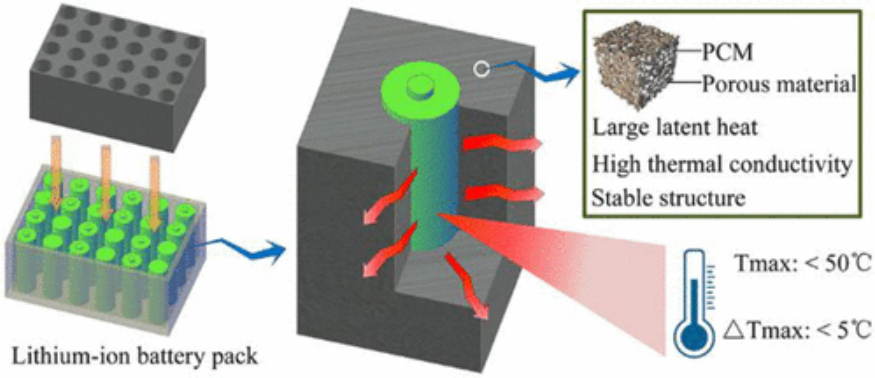
Phase Change Materials: Optimizing Systems and Structures

Advisors: Lou Kondic & Linda Cummings

Phase Change Materials (PCMs) are substances that undergo a phase transition when exposed to sufficient temperature variation. The most useful are those that melt and solidify in the relevant thermal regime, with accompanying absorption or release of latent heat. This ability to store and release thermal energy makes PCMs promising for clean-energy applications, including thermal energy storage, energy-efficient buildings, and battery thermal management. The figure below illustrates a PCM matrix used in battery thermal management---the PCM, in green, is distributed within a porous structure to absorb and redistribute heat.

PCMs used in isolation suffer from two main issues that limit their applicability: mechanical stability, particularly when the phase change is solid to liquid; and heat-transfer ability. Embedding PCMs in a porous matrix with high thermal conductivity and a small spatial scale can mitigate both issues; examples include metal wires or carbon nanotubes. The proposed project focuses on modeling both the matrix and the PCM to identify optimal structural properties. The project will use state-of-the-art modeling of thermal flow through interconnected networks, combined with modeling of PCM-related thermal effects, and will combine topological data analysis with Machine Learning to devise setups with optimal properties. The project will be carried out in collaboration with Prof. Marco de Paoli from TU Wien, who is the PI on a large ERC project focused on PCMs.



Support: NJEDA Clean Energy (current), DOD (pending).