Thrust 4: PCM Nanoemulsions

- Long-term Objective: Elucidate the formation, stability and transport phenomena of PCM nanoemulsions, including
  - The selection of surfactants for best nanoemulsion stability
  - Development of PCM nanoemulsions with good flow and heat transfer properties for cooling and heating applications

- Current objectives: Formation of stable octadecane nanoemulsions, and measurement of their thermophysical and rheological properties using DSC, Lumisizer, variable temperature Rheometer and NMR.

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- Approach:
  - Evaluate the use of HLB number and HLD criterion for surfactant selection (CCNY).
  - Use NMR to study effects of phase change on molecular structures in nanoemulsions (CCNY).
  - Long term thermal cycling studies at Fraunhofer ISE.
  - Use multi-dimensional NMR to characterize the molecular compositions and structures of the nanoemulsion phases and their interactions with adsorbed species (IPF in Germany).
  - Evaluate the nanoemulsion properties for practical applications of PCM nanoemulsions to the refrigeration industry (IRSTEA).

Computational Approach in Thrust 4

- Computationally study the destabilization processes using a lattice Boltzmann method including the microstructural evolution and kinetics of Ostwald ripening in a high volume fraction regime.

- Use both particle resolved and point particle (DEM-LBM) approaches to predict the apparent viscosity increases with the mass fraction of PCM at a given temperature.

- Use a hybrid sharp interface thermal model and phase field LBM to accurately capture phase change heat transfer across interfaces.