Research Thrust-2: Nano-manufactured Systems for Space Applications

Sub-project-3: Novel Heat Transfer Fluids for Lunar Surface Applications

Statement of R&D Problem

Human spacecraft have historically used single-phase fluids (liquid) in either a one-fluid (Apollo) or two-fluid (Shuttle, ISS, Orion) architecture configuration. Liquid single-phase heat transfer fluids have been successfully used in a variety of applications for human and robotic spacecrafts. For future lunar applications, vehicles and surface assets will be required to survive and operate through the extreme temperatures experienced on the lunar surface. Thermal conditions can range from 70 - 100 K during the lunar night to 400 K near the subsolar point at lunar noon. Since the fluid properties vary with temperature, a fluid that functions very well at a certain temperature may not be suitable at another temperature.

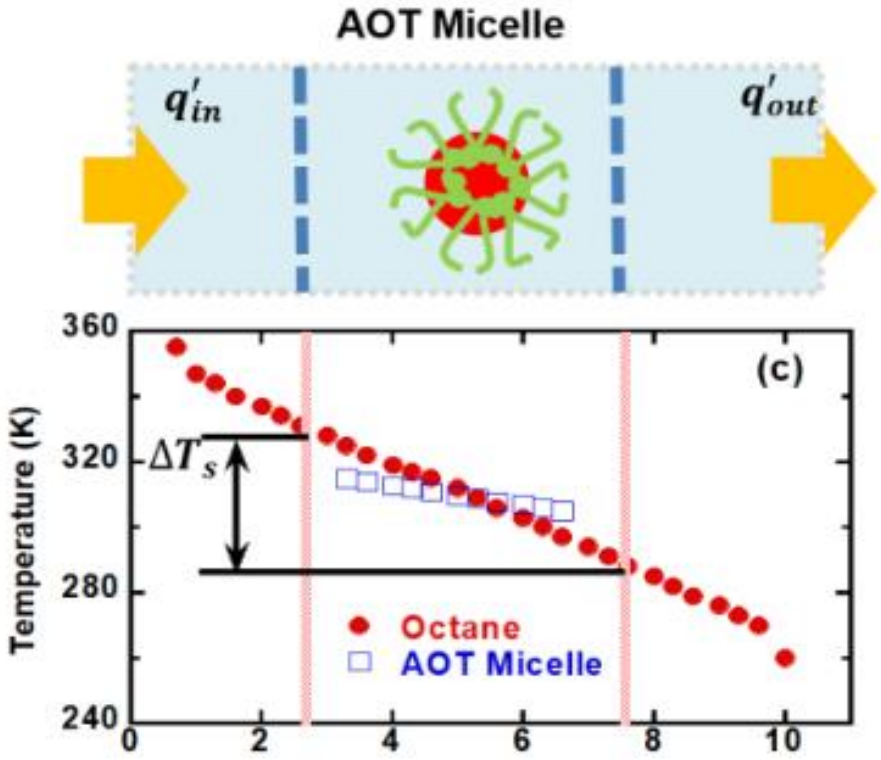
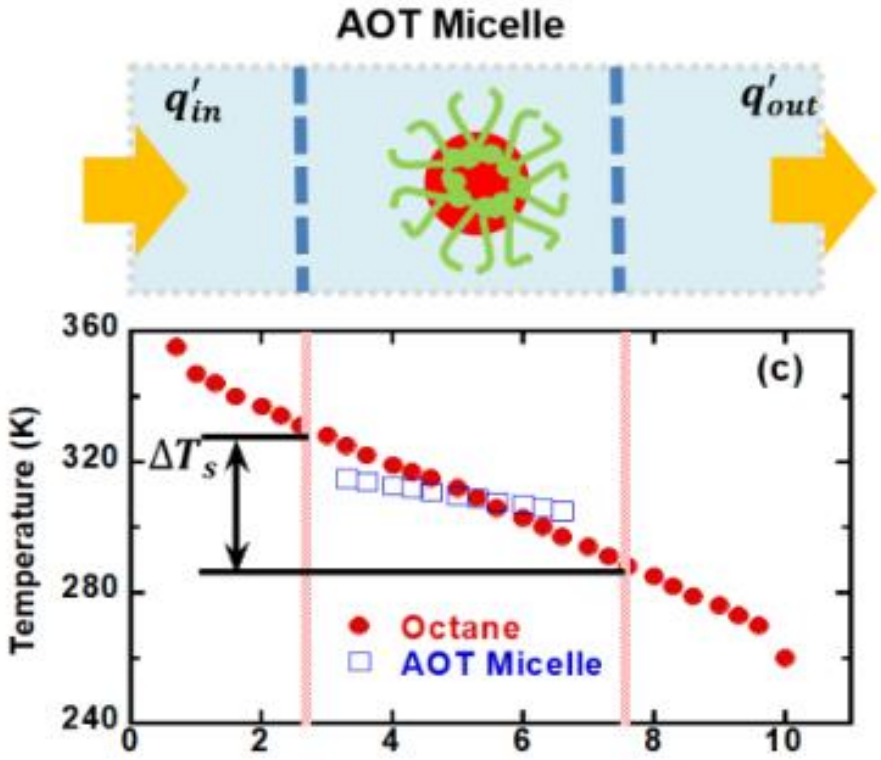


Illustration of nano-structure inside the microemulsion, and a sample microemulsion made based on FC72

Statement of R&D Problem

This is especially relevant for space applications, since the temperature range in these applications is often very different from the temperature range in terrestrial applications. To date, several heat transfer fluid candidates have been explored and investigated for single-fluid human spacecraft thermal control systems, which include, but not limited to, nanofluids, dilute emulsion, nano emulsions, and state-of-the-art external fluids such as HFE 7200. However, they fail to fully meet either toxicology hazard or performance characteristics requirements considered for the crewed vehicles.



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