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HYBRID MULTILAYER THERMAL INSULATION DESIGN FOR LUNAR MICRO ROVERS BASED
ON SILICA AEROGEL**Abstract**

One of the main challenges in the design of lunar micro rovers is extending their operational life beyond a single lunar day (14 Earth days) due to the extreme nighttime temperatures, which reach approximately 50K. Current models are limited to daytime operation, with low autonomy and thermal protection. This work proposes a hybrid multilayer thermal insulation (MLI) system that combines reinforced silica aerogel (0.013W/m-K) with reflective Mylar layers to minimize heat loss during the night. The design was simulated using COMSOL Multiphysics, analyzing conduction, radiation, and internal heat dissipation. A retractable structure called Kueta was developed, which folds the rover into a compact cube at night, reducing the surface area and conserving the accumulated heat. The system was designed in SolidWorks and integrates a basic GNC system for autonomous activation. The solution enables survival through the lunar night without radioactive sources, supporting low-cost lunar missions.