# Enabling self-propelled condensate flow during phase-change heat rejection using surface texturing

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## Summary and Objectives

An innovative method of phase-change **heat rejection** via condensation suitable for microgravity environment is proposed. The **key innovation** lies in the surface microstructure design of the condenser, which is in the form of repeating asymmetric ratchets interspersed with drainage microchannels (see Figure). The **central hypothesis** of the proposed work is that asymmetry in surface microstructures can cause self-generated directional motion of the condensate. The **overall objective** is to characterize the effects of surface microstructures on droplet/ condensate film dynamics and on heat transfer rate by variation of the ratchet surface properties (hydrophilic, hydrophobic, or a combination).

## Approach and Methods

The microtextured surfaces will be fabricated in silicon. The approach includes phenomenological modeling coupled with experiments. The experiments will provide input data for the model as well as be used for model validation. Droplet dynamics will be captured using high-speed photography.

## Potential Impact

The proposed work presents a fundamental study in condensation heat transfer relevant to terrestrial and microgravity environments. Together with a novel evaporator design, being currently developed by the group, the condenser can potentially result in a phase-change thermal management loop (see Figure) that is **passive, self-regulating, reliable and lightweight**.

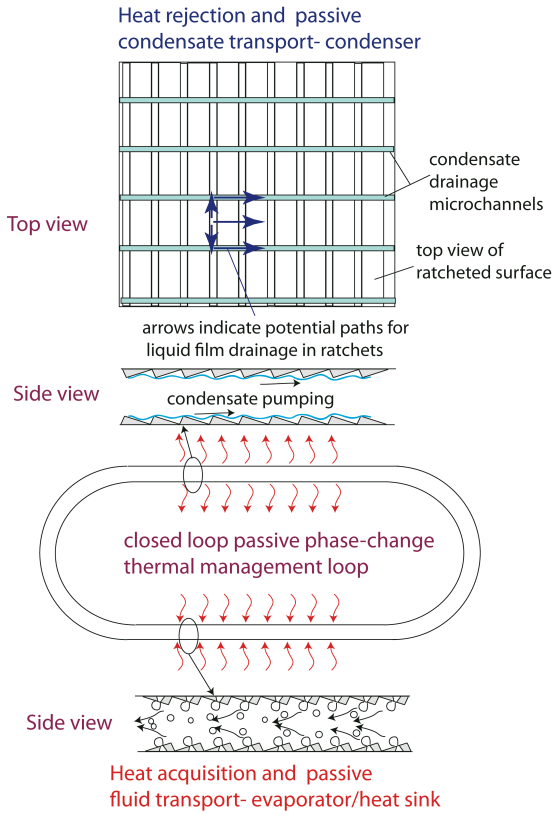


**Figure-** Concept of a passive closed loop thermal management system based on microtextured evaporator and condenser. The focus of the proposed work is on characterization of the condenser surface morphology on heat transfer and condensate flow.

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Heat Rejection- Passive condensate transport via uniquely microtextured surfaces

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