Capillary assisted low pressure combined evaporator and condenser

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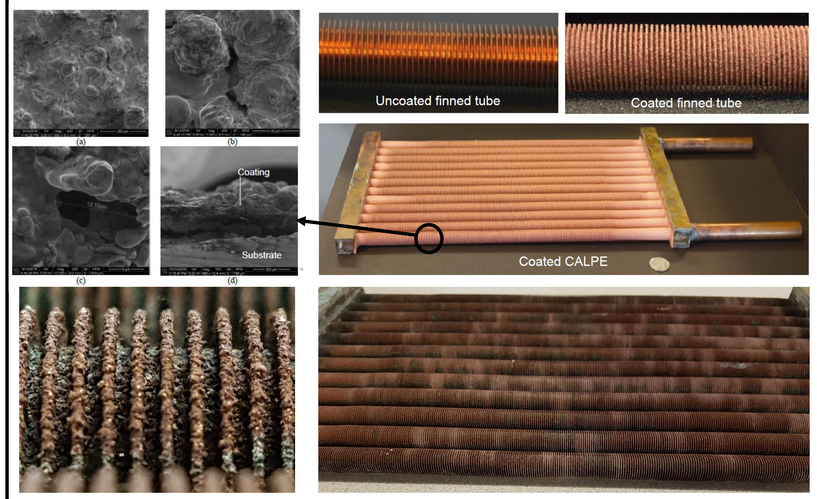
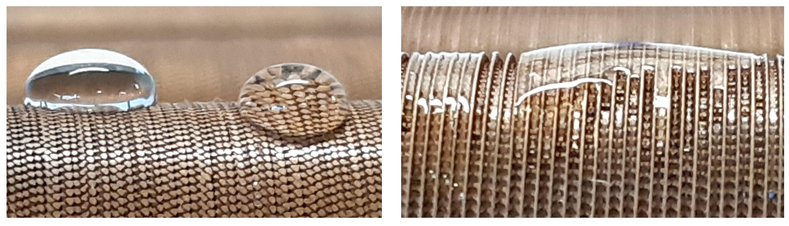
Capillary assisted low pressure evaporator



- Porous copper coated evaporator and condenser
- Combined evaporator and condenser to reduce the cost

Surface properties characterization



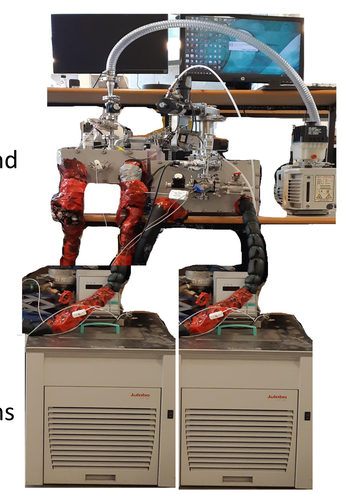
- Surface Properties; Hydrophobic vs hydrophilic

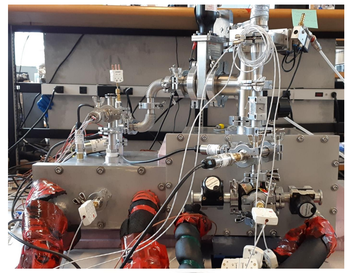
Combined evaporator and condenser

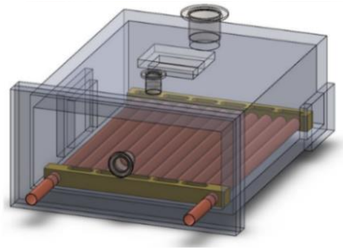
Monitoring System

Combined evaporator and condenser

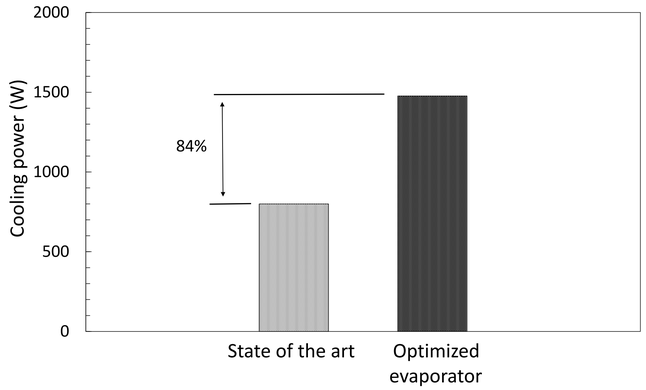
Temperature Control Systems





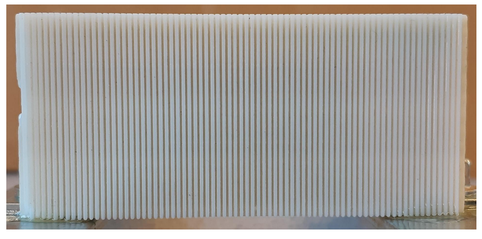


Optimization



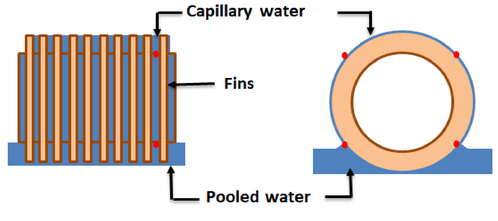
- Genetic algorithm was used for optimization
- 6 geometry parameters were considered as variables
- A 84% increase in cooling capacity can be achieved by using optimized design points

Optimal design manufacturing



- Spray coated low pressure capillary evaporator was successfully tested as a condenser
- Optimization based on heat exchanger geometry lead to power density improvement
- An optimized combined evaporator and condenser can be 3D printed

Analytical modeling



$$\frac{\partial}{\partial x}(\rho \bar{u}(x)^2 \delta(x))dx = \rho g \delta(x)dx + \sum Surface\ forces$$

$$\rho \bar{u}^2(x)\frac{d\delta(x)}{dx} + 2\rho\delta(x)\bar{u}(x)\frac{d\bar{u}(x)}{dx} = \rho g\delta(x) + \sigma\frac{d\kappa(x)}{dx} - \delta(x)\frac{\partial p}{\partial x} - p\frac{d\delta(x)}{dx}$$

- Liquid axial flow, pool boiling, 2D bulk heat transfer, thin film evaporation, and non-evaporating region

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