



Capillary Action Heat Exchanger (ROI #2011-09)

Description

- Microfabricated / MEMS heat exchanger.
- Thermal energy absorbed and transferred to coolant yielding evaporation / phase change and energy transfer from heated surface.
- Operation based on capillary action of coolant (working fluid) in micro channels.
- Working fluids may be varied for different temperature boiling points.
- Channel materials may be varied to include polymers and metals.

Advantages

- Exchanger may be self-contained without external pumps due to capillary action of working fluid across the heated exchanger surface.
- Exchanger relies on working fluid phase change to remove thermal energy from the heated source. This provides increased capacity for thermal absorption.
- Channels may be fabricated of various materials from polymers to thermally conductive silicon or copper metals.
- High aspect ratios of channels yield increased thermal energy transfer.
- Design is highly scalable with the ability to add increased channel numbers for increased surface area coverage.
- Planar design allows integration with other devices for thermal control including CPU stacks and thermoelectric devices.
- Light weight. Lack of external pumps reduces overall device / system weight .
- Lower manufacturing costs with metal incorporation (versus typical micro-fabrication processes).

Areas of Application

- CPU chip cooling
- Ambient thermal energy absorption for thermoelectric power and “green” energy production and energy harvesting applications.
- Solar cell cooling for increased operating efficiency of solar cells.
- Incorporation with thermoelectric devices for improved temperature gradients and increased power output.

Patent Status

- Patent pending

Publications

- E. Ogbonnaya, C. Champagne, and L. Weiss. *Simple and low cost method for metal-based micro-capillary channels for heat exchanger use.* Journal of Micromechanics and Microengineering, **23**:1–10, 2013.