



Vapor chamber Technology for Thermal Management of PV Junction boxes

Advanced thermal management to enable high performance and reliability PV panels

U.S. DEPARTMENT OF ENERGY

Challenges

Junction Box

Failed Junction Box



Frequent Shading, Hot-spot heating,
No thermal management

“A cost effective and reliable solution to address the thermal management challenges for biasing diodes in junction boxes in photovoltaic panels.”

State-of-the-art

Thermal management for power electronics

High Thermal Conductivity Materials

Graphene
Diamond

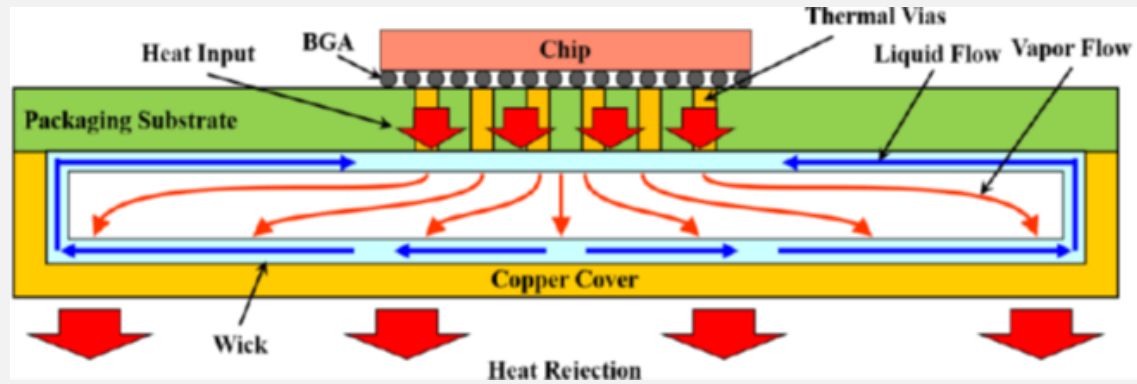
Micro-Fluidics

Microchannels
Thermosyphons

Liquid-cooled solution

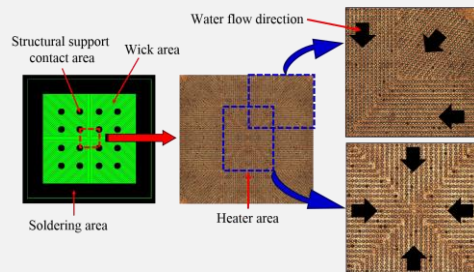
Heat pipes
Vapor chambers
Cold plates

Proposed solution Vapor Chamber Integration

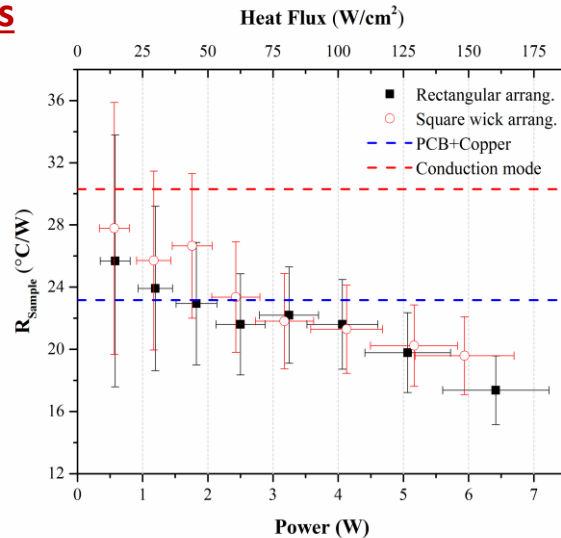
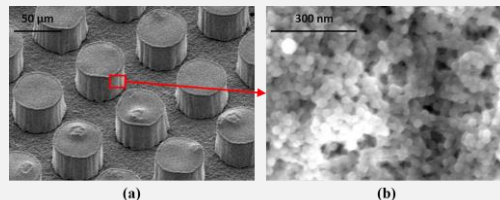


Results

Sub millimeter Vapor Chamber



SEM Image of Wick Structure



Heat Transfer Performance Curve

Benefits

- ✓ Effective heat spreading from diodes, reducing maximum temperatures
- ✓ Reduction in maximum heat flux, allowing for fully passive operation
- ✓ Increased reliability of junction box; greater solar yield
- ✓ Multiple form factors possible

The Team



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