



# Modular Thermal Hub

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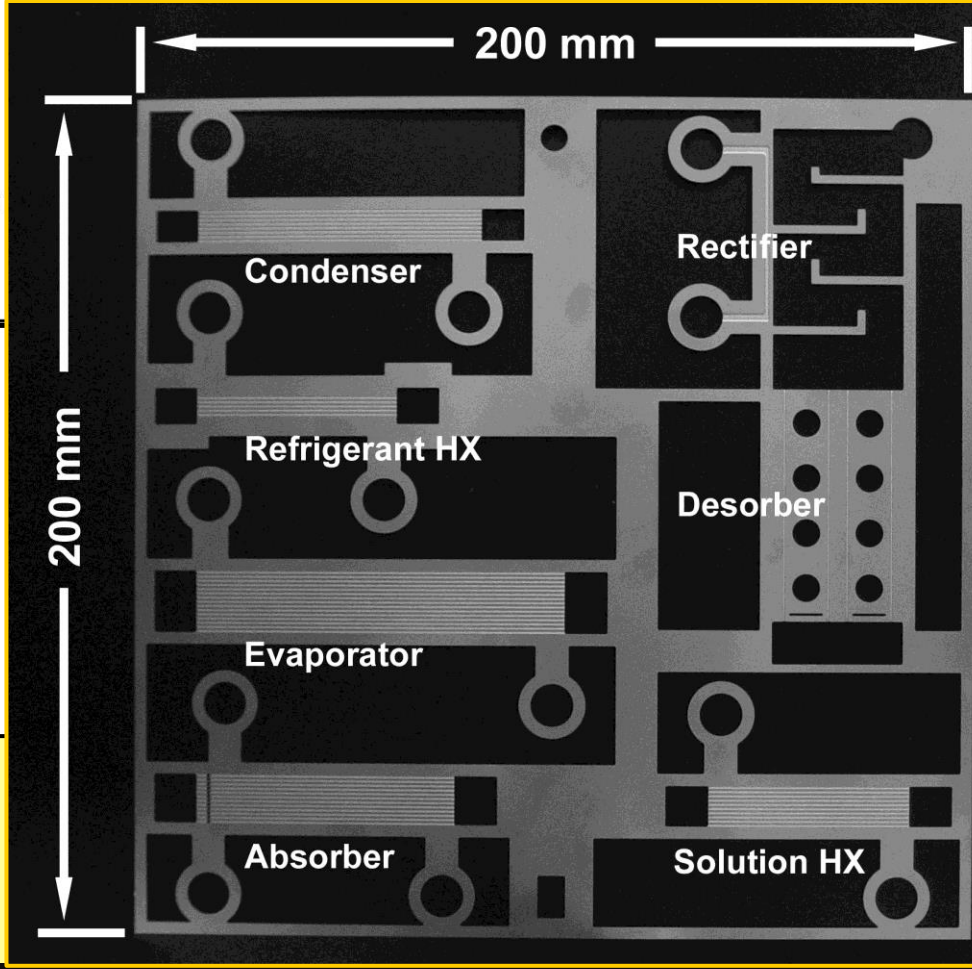
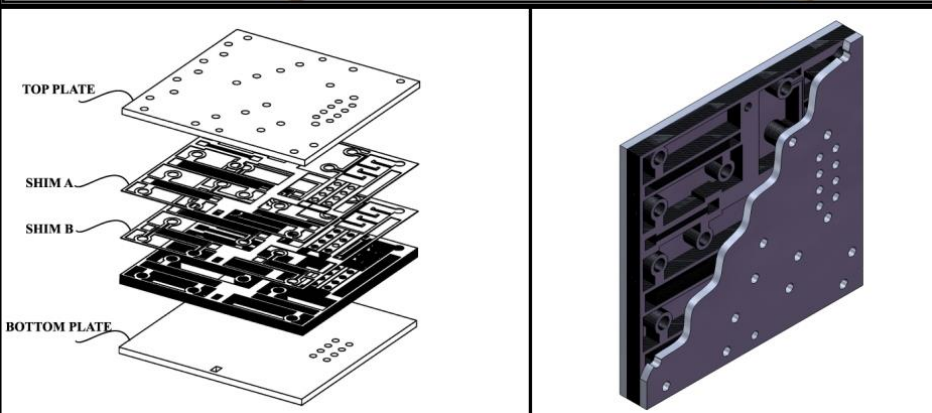
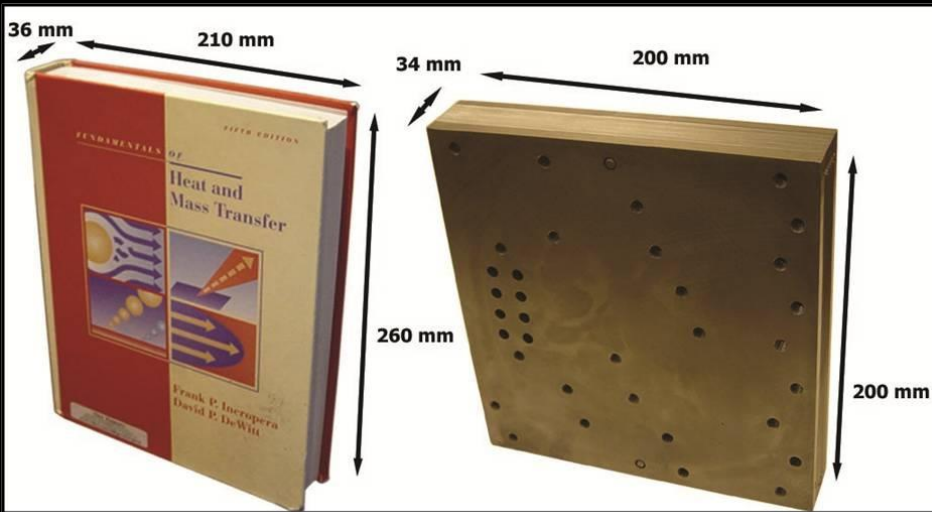
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Friends of Sorption Workshop

July 2018

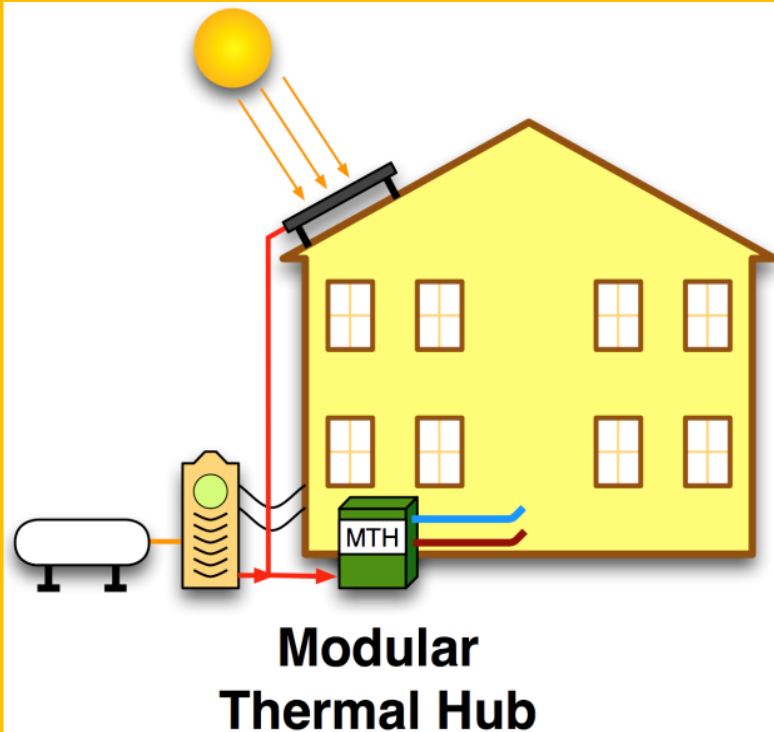


# Innovation: Microscale Monolithic Absorption System



# Differentiation: Modular Thermal Hub

No electricity, no synthetic refrigerants, replaces several subsystems



- Compressor replaced by heat exchangers, no moving parts
- Size and first cost challenges address by microscale heat transfer and monolithic integration
- Miniaturization possibilities, low charge of fluids
- Versatile: waste heat/natural gas/solar driven
- Focus on simplicity instead of complex systems for minimal additional gain
- “Near-Lossless” energy conversion on-site
- Enables maximum primary source efficiency

# Market Segments/Value Proposition

## Stationary Building Applications

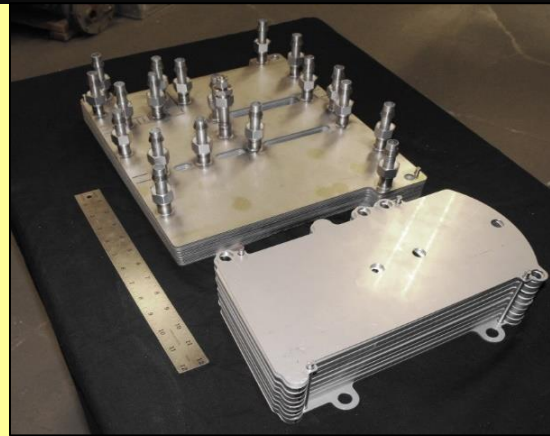
- Gas-fired residential, light-commercial building HVAC, water heating
- CHP using waste heat from distributed power generation
- Standalone gas-fired heat pump water heaters
- Quick service restaurants – waste heat driven cooling and refrigeration
- Diesel engine generator waste heat driven cooling and heating
- Vending machines and convenience store coolers
- Collocated heat driven food processing and refrigerated food storage/warehousing

## Vehicular and Marine Applications

- Automobiles: waste heat from exhaust, engine coolant for passenger cooling and heating
- Refrigerated transport trucks
- Marine boats and fishing vessels, waste heat driven cooling and freezing of catch



# Scale-up, Fabrication, Next Steps



- Gas-fired heat pump water heater (**3 kW<sub>n</sub>**)
- Residential Thermal Hub (**3.5 kW<sub>c</sub>**, AC, heating, water heating)
- Residential gas-fired cooling (**7 kW<sub>c</sub>**)
- Forward operating base unit (**2.6 kW<sub>c</sub> @ 52°C** ambient)
- Military/civilian dual use unit (**10.5 kW**) under development
- **High volume, low cost production**
- **Autonomous control**
- **Field testing and partnerships**