

Cooling of electronic components and enclosures require devices through which air or other fluids are forced. Convection and conduction passes heat from one media to another and then typically heat is carried out of the enclosures by the flow of the cooling fluids. In open systems, fins and more recently foams have been used as the heat transfer surface.

Currently, fin-based heat exchangers are the most common, however, as the needs for more efficient heat transfer increase, more innovative heat exchanger designs and devices are emerging. Many times, the parts being cooled, are attached to copper or aluminum base plates or heat, but more recently composites such as Al:SiC or Al:Graphite are being substituted to control CTE mismatch.

S-Bond™ has the unique capability to join all the conventional and all of the new materials being considered for advanced thermal management devices.

### S-Bond™ joining offers...

- Lead-free alloys.
- Improved thermal attachment.
- More reliable joints than glues.
- Materials versatility; joining all materials.
- Joining in a single step.
- No process change as materials change.
- Lower cost joining.
- Flux elimination
- Pre-plating elimination, thus improving costs and environmental impact.

S-Bond™ joins most materials in a single step with no flux or pre-coating required. The S-Bond™ alloys are metals, thus offering very good thermal conductivities.



- Aluminum fins
- Cu-Al joints
- Al-fabric to tubes
- Cu-Al tubes



### Thermal conductivity...

- 50 W/mK
- 10x better than filled adhesives.

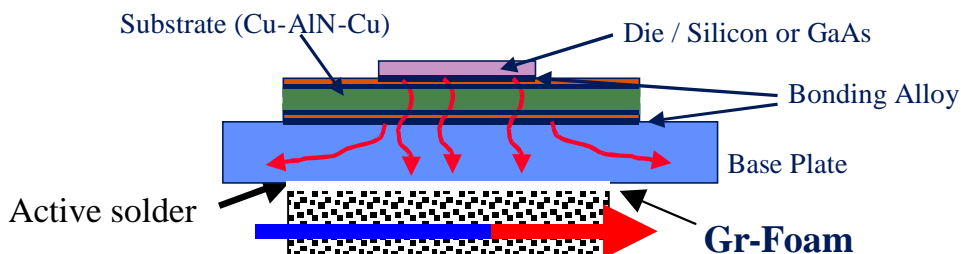
### S-Bond™ does not flow...

- permeable materials joins weaves / foams.
- closed cooling passages are not plugged.
- does not require masking.



Thermal management devices that can be improved via S-Bond™ joining include:

- Folded or extruded fin-plate heat exchangers
- Fabric-tube panels
- Heat pipes
- C:C / Graphite cores
- Metallic foam cores



An example of thermal foams bonded to electronic packages is shown to the left. NOTE: S-Bond™ can be used to bond all the interfaces, including: Si / AlN or Al<sub>2</sub>O<sub>3</sub> / Metal Base / Gr-Foam.

### S-Bond™ Characteristics...

- All metal alloys.
- Alloy 220 joins from 250-270°C.
- Alloy 400 joins from 410-420°C.
- Low capillarity, pre-placement required.
- No flux required.
- Active elements eliminate pre-metallization requirements.
- Can join most metals, ceramics and composites.



### Carbon:Carbon Composites

- S-Bond™ alloys wet and adhere to C:C.
- Can join C:C to all metals.
- Produces thermally stable cold plates.

### Applications...

- Fin-Plate heat exchangers
- Foam core heat exchangers
- Cross-flow / Fin heat exchangers
- Composite Al-MMC heat spreaders
- Heat pipes
- Composite Cold plates

Please contact us to discuss how S-Bond™ joining can become a solution for your thermal management designs and components...MRi offers support, materials, joining services and integrated solutions for your production needs.



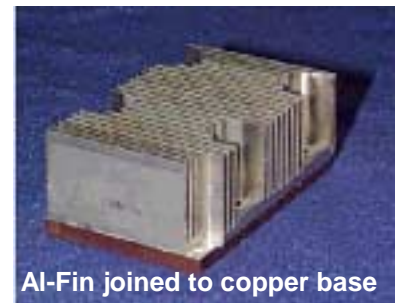
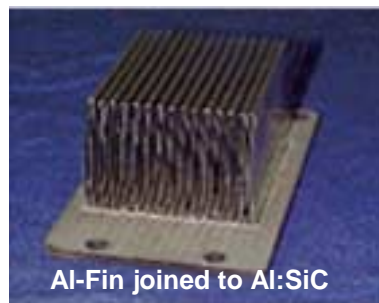
### Aluminum Foams

- No excessive filling of pores.
- Wets and joins dissimilar materials.
- High thermal conductivity joints.



### Graphite Foams

- Thermal heat transfer rates to 20,000 W/m<sup>2</sup>K.
- Wets and joins graphite, aluminum, copper and Al:SiC.
- Can be directly bonded to Al<sub>2</sub>O<sub>3</sub> or AlN substrates.
- Direct attachment to Silicon and SiC demonstrated.



### Finned Heat Exchangers

- Joins aluminum to Cu, Cu-W, Al-MMC (composites)
- Excellent thermally efficient bonds.
- Excellent Joint strengths with aluminum and copper.
- Ability to direct bond electronic packages on bases.

[www.materialsresources.com](http://www.materialsresources.com)