S-Bond Technologies, LLC	S-Bond® Joining Thermal Management	Application Bulletin Bulletin No. A14.2.1.11

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.

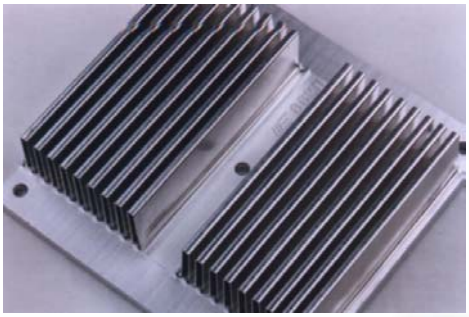
Currently, fin-based heat exchangers are the most common, however, as the needs for more efficient heat transfer increase, more innovative heat exchanger designs and devices are emerging. Many times, the parts being cooled, are attached to copper or aluminum base plates or heat, but more recently composites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

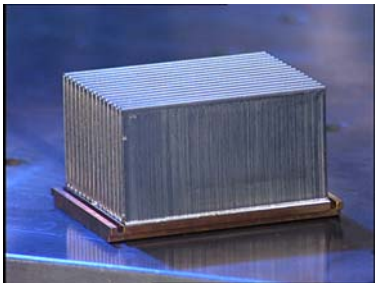
S-Bond joining offers…

- 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 precoating 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**

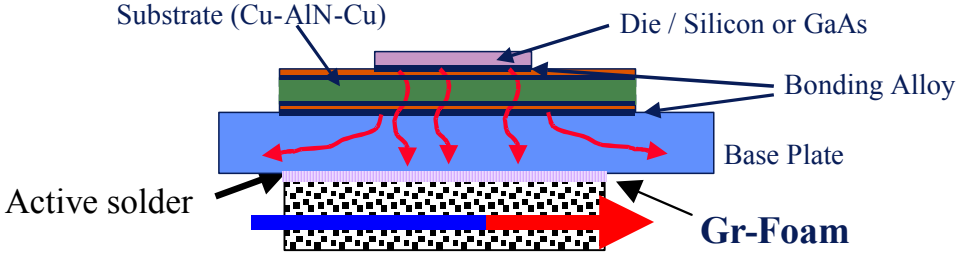


<u>Thermal conductivity…</u>
- 50 W/mK
- 10x better than filled adhesives.

<u>S-Bond does not flow…</u>
- 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

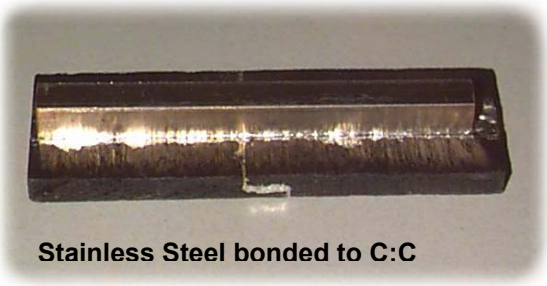


An example of thermal foams bonded to electronic packages is shown to the left. NOTE: S-Bond can be used to bond all the interfaces, including: Si / AlN or Al_2O_3 / Metal Base / Gr-Foam.

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.


C:C joined to aluminum


Stainless Steel bonded to C:C

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…

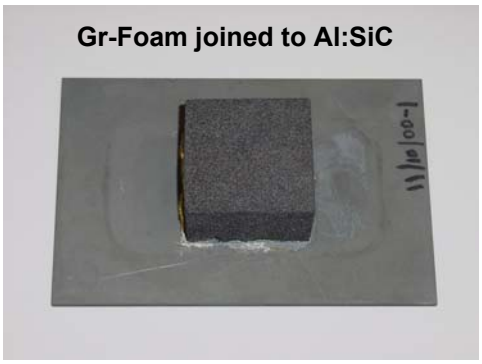
- Fin-Plate heat exchangers
- Foam core heat exchangers
- Cross-flow / Fin heat exchangers
- Composite Al-MMC heat spreaders
- Heat pipes
- Composite Cold plates

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.


Al-Foam joined to copper

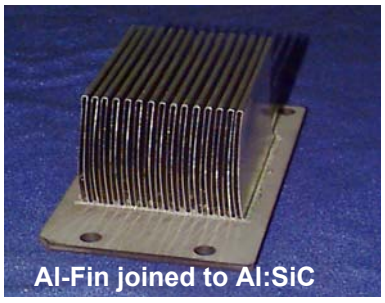
Aluminum Foams

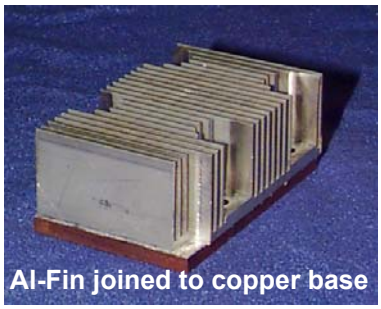
- No excessive filling of pores.
- Wets and joins dissimilar materials.
- High thermal conductivity joints.



Graphite Foams

- Thermal heat transfer rates to 20,000 W/m^{2}K.
- Wets and joins graphite, aluminum, copper and Al:SiC.
- Can be directly bonded to Al_2O_3 or AlN substrates.
- Direct attachment to Silicon and SiC demonstrated.


Al-Fin joined to Al:SiC


Al-Fin joined to copper base

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.

811 W. Fifth Street, Unit 2
Lansdale, PA 19446
215-631-7114 FAX 215-631-7115

www.s-bond.com
Email: info@s-bond.com