S-Bond Technologies, LLC	**S-Bond® Joining** **Thermal Management Components**	**Application Bulletin** Bulletin No. SBT-TM001-RevA

S-Bond has the unique capability of joining conventional and new material being considered for advanced thermal management devices. S-Bond® can join all metals including steel, copper, aluminum alloys, stainless steels, titanium, nickel alloys, carbon based materials, graphite foams, pyrolytic graphite and even thermally conductive ceramics used in electronic packaging, including AIN and BeO.

The joints produced are:

- Strong (> 5,000 psi shear), exceeding the strength of many thermal management mat'ls
- Ductile, based on Sn-Ag or Sn-In alloys
- Thermally conductive, over 50 W/(m·K)

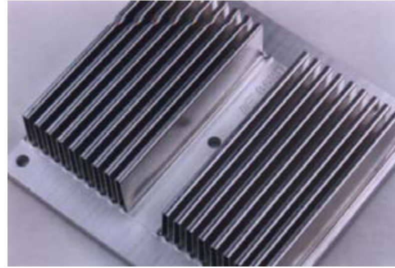
S-Bond joints characteristics

- Lead-free.
- Joining process is fluxless
- No plating is required on metals or ceramics
- Improved thermal attachment.
- More reliable than conductive glues.
- Materials versatility; joining all materials.
- Lower cost joining.

Component Examples

S-Bond easily joins aluminum and copper for cut or extruded fin, folded fin and foams. The process is fluxless, eliminating clean up and flux entrapment, while the lower S-Bond joining temperature lowers distortion and softening of base materials, compared to dip braze joining. The figures on this page show various components that can be made cost effectively.

These components show the versatility of the S-Bond joining, where fins, fabric, foam and tubes of various combinations of materials have been joined.



Folded Al- Fin to Al Heat Sink

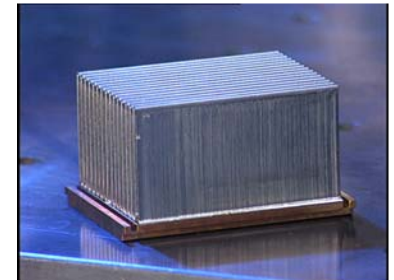
Thermal conductivity…

- 50 W/mK or higher
- 10 x better than filled epoxy

S-Bond does not flow…

- doesn't permeate materials
- joins weaves / foams.
- maintains cooling passages.
- filler metals remain where placed, low capillarity

Al & Cu Tube – Al - base Cold Plate

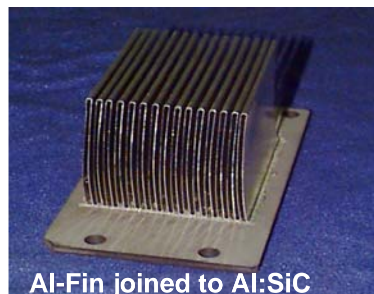


Folded Al- Fin to Copper CPU Heat Sink

NASA-Heat Exchanger Blanket St. Steel tubes – Al-Fabric

Heat Exchangers / Heat Sinks / Heat Pipes / Cold Plate

- Joins Al, Cu, Cu-W, most metals, Al-MMC (composites)
- Thermally efficient bonds with minimum voids
- No trapped flux
- Direct bonding to a variety of electronic packages including Si, GaAs, AIN, Al_2O_3, and BeO



Al-Fin joined to Al:SiC

Al-Fin joined to copper base

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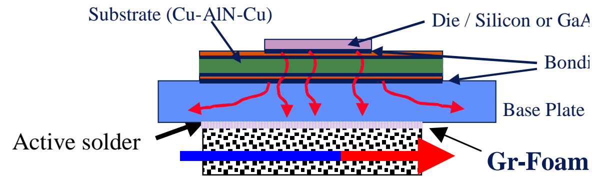
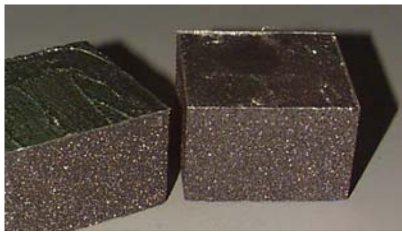
Graphite-Carbon Materials

Gr-Foams and pyrolytic graphite offer advances in thermal management and are emerging as a core material in many components S-Bond Alloy 220 has been shown to wet and adhere to the surface of the graphite foams. After precoating with molten S-Bond alloy, the heated graphite foams can be joined to aluminum face sheets or other types of metals and composites.

Graphite based foams have been bonded to AlN electronic packages, as depicted below. S-Bond provided the filler / thermal interface for such a package.



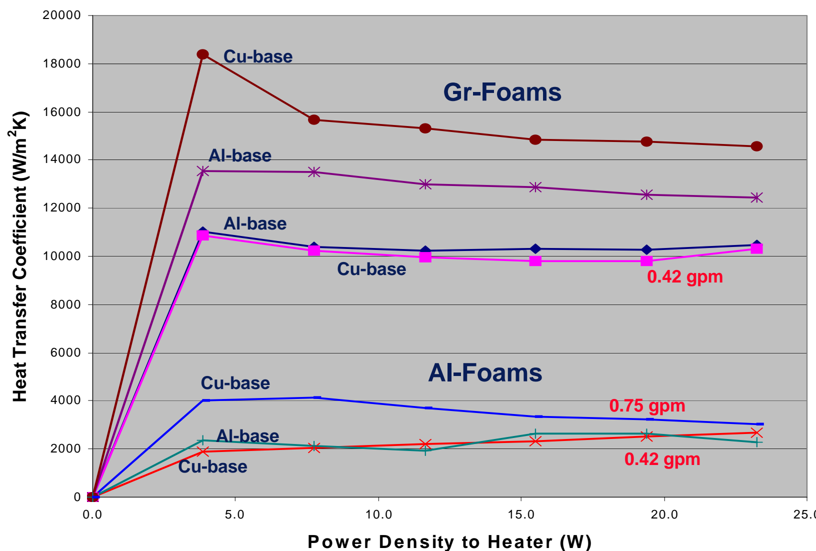


Gr-Foam wetted with S-Bond

Al-face sheets joined to Gr-Foam with S-Bond.

Gr-Foam joined to Al_2O_3

S-Bond alloys wet and encapsulate the Gr-foam webs, leading to adherence and gripping around the Gr-foam webs, thus creating strong and thermally conductive joints. Thermal treatments with S-Bond materials on graphitic surfaces enable most graphite materials to be solder joined with S-Bond, enabling improved thermal resistance. The figure below shows the thermal resistance of S-Bond joined Gr-foam heat exchanger plate to a bonded aluminum foam



The versatility of S-Bond joining of carbon materials is shown in the heat sink / mounts for satellite batteries. This shows S-Bond joining C:C composite joined to aluminum.

Graphite-Carbon

- Thermal heat transfer rates to 20,000 W/m^2K.
- Wets and joins graphite to metals and MMC's
- Bonded to Al_2O_3 or AlN substrates.
- Direct attachment to Silicon and SiC

Offering…

- Joining services for prototypes and production
- Joining materials

Contact us to evaluate S-Bond joining solutions for your thermal management component applications.

Markets Served

- Formula 1 Auto Engines
- Telecommunications
- Aerospace / Radar
- Avionics
- Semiconductor
- Powers supplies
- Power conversion units
- Satellites
- Electronic
- Computers

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