S-Bond Technologies, LLC	S-Bond® Joining of Sputter Targets	Technical Bulletin Bulletin No. SBT-AP-001 (RevA)

S-Bond Active Solder Joining

S-Bond® active solders enable the joining of dissimilar metals and ceramics to each other and to other metals. S-Bond's patented alloys have active elements such as titanium and cerium added to Sn-Ag, Sn-In-Ag, and Sn-Bi alloys to create a solder that can be reacted directly with the metallic and/or ceramic surfaces prior to bonding. S-Bond filler metal alloy produce reliable joints with…copper, aluminum, steel, stainless steels, titanium, chromium, nickel alloys, refractory metal alloys and many ceramics including alumina, zirconia, AlN, SiC and joins to most semiconductors including Si, GaAs, CIGS, etc. S-Bond joins…

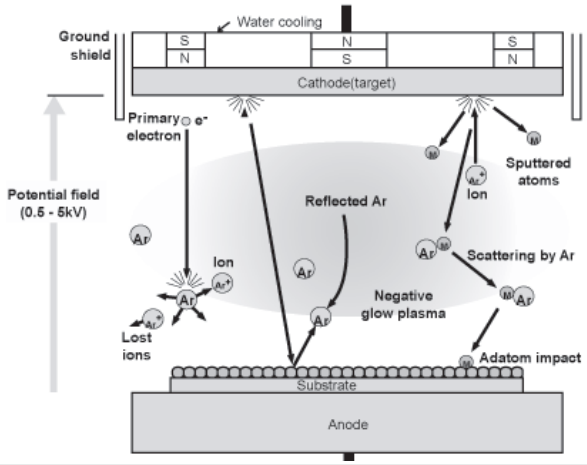
- Directly without the use flux.
- Without pre-plating steps, eliminating multiple step coating processes.
- At temperatures below 400ºC, preventing distortion and softening of metals and preventing ceramic fracture.

The joints produced by S-Bond active solders are:

- Strong (> 5,000 psi shear)
- Ductile, based on Sn-Ag or Sn-In alloys
- Capable of service temperatures up to 190ºC.

Sputter Targets

Sputtering is a physical vapor deposition process that utilizes the kinetic energy on highly accelerated inert gas ions, to dislodge elemental atoms from a "sputter target". The collisional impact of these highly energetic particles eventually heats the target to a point where the target can distort, crack and/or melt. Therefore, cooling backing plates are normally used. Sputter targets are highly engineered materials systems that join the sputtering materials to metallic backing plates. The figure below illustrates the sputter process and sputter target set-up.



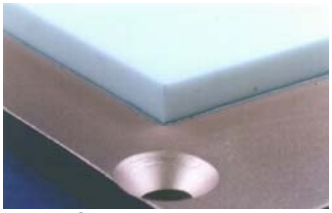
Sputter targets need to be well adhered to backing materials such as copper which are normally water cooled. The sputtering targets require good thermal and electrical contact to their backing plates to permit good heat conduction and the conduction of ions to complete the sputtering circuit. Conventionally, Sn, Sn-Ag, Pb-Sn and In solders have been used as bonding materials. These conventional solder bonding filler metals are melted onto surfaces that have been cleaned chemically with fluxes and/or have been preplated with Ni, Ag or Au. Other bonding techniques have involved diffusion and/or HIP bonding. Diffusion bonding methods are normally used to bond metals with more similar thermal expansion behaviors.

S-Bond Joining of Sputter Targets

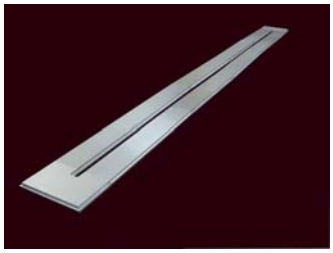
S-Bond® active solder joining eliminates the need for flux and preplating while offering a capability to directly bond to ceramic and to semiconductor materials. S-Bond® simplifies the joining of many of the typical sputter target geometries, the joining materials are Pb-free and their temperature capabilities exceed that of Indium. For example, S-Bond 220 and 220M joined sputter targets interfaces have shear strengths of 3 – 5,000 psi (20-32 MPa) and an be taken to 195ºC without significant lowering of the room temperature values.

Examples of Joined Sputter Target Components

Metal sputter targets



Ceramic Sputter Target



Magnetron sputter targets

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Sputter Target Materials
Target materials that can be joined with S-Bond® filler metals to copper and other backing metals include…

Metals

Gold	Silver
Nickel	Vanadium
Antimony	Tellurium
Germanium	Aluminum
Titanium	Copper
Tantalum	Cobalt
Iron	Chromium
Manganese	Stainless steel
Molybdenum	Tungsten

Semiconductors / Compounds / Ceramics
Silicon
Gallium Arsenide
Zinc Sulfide
Silicon Dioxide
Indium Tin Oxide (ITO)
Al – Zinc Oxide (AZO),
Indium Zinc Gallium Oxide
Aluminum Oxide & Zirconium oxides
Most other Metal Oxides
Titanium carbide & Silicon carbide
Copper indium gallium (di)selenide (CIGS)
Cadmium telluride

S-Bond joins ceramic and metal surfaces and is much more tolerant of joint variations due to the nature of the S-Bond alloys' higher surface tension. S-Bond joining does not use chemical fluxes that must be cleaned up or could etch metallic components, leaving cosmetic defects. S-Bond® is also used as an "active" solder layer to facilitate Reactive Nanotechnologies, NanoBond® low temperature joining methods. In these processes, filler metals, such as S-Bond® 220M are pre-tinned on the sputtering target and backing plates and solder alloys then are pre-placed to fill the joints. Pre-placed Nanofoils® are then ignited to provide only localized heating, thus minimizing CTE related distortion and target material cracking.

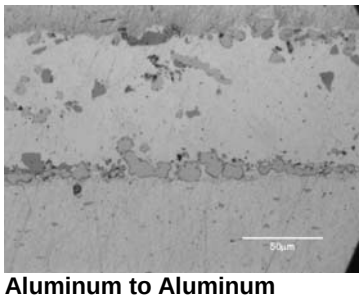
Image courtesy of Reactive Nanotechnologies

S-Bond Materials for Sputter Target Joining

S-Bond Alloy	*T_m (ºC)*	*$T_{service}$*	*Joint Strength (to copper, psi)*
115 (In-Sn-Ag)	120	100	2 – 3,000
130 (In-Sn-Ag)	135	120	2-3,000
140 (Sn-Bi-Ag)	150	135	3-4,000
220 (Sn-Ag)	235	195	5-6,000
220M (Sn-Ag)	235	195	5-6,000

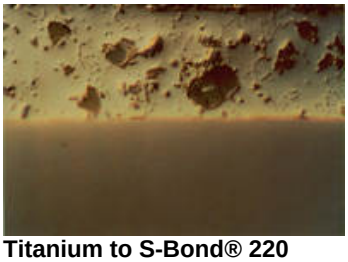
Note: SBT 220M is formulated for joining semiconductors and silicon based compounds and has been found to be excellent for bonding to refractory metals, such as Mo, W, and Ta.

The figures below highlight examples of joint structures that can be achieved with S-Bond 220. Joint bonded areas have been shown to exceed 98%, dependent on the techniques used.


Aluminum to Aluminum


Stainless Steel to Al_2O_3


Copper to Al_2O_3


Titanium to S-Bond® 220

S-Bond® filler metals are versatile and can be used to bond a range of metals, compounds.

Contact us for a demonstration of S-Bond's unique and capability to meet many of your sputter target joining requirements.

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