

Advanced Joining Technology: Simple, Strong, and Secure

Originating Technology/ NASA Contribution

The space-age materials that NASA employs in its spacecraft and satellites have different attributes than the building materials that can work for Earthly uses. These materials do not behave like the typical construction materials, and therefore, require new methods for construction.

Work done at NASA's Langley Research Center in the realm of active solder joining has led to a new, self-bonding solder that enables high conductivity, as well as the metallic joining of carbon and ceramic materials to a wide range of metals. The original work involved evaluating high- and low-temperature joining technologies for joining carbon composite structures for use in thermal management and reusable launch vehicles. The initial plan for this innovation was to lower the weight of battery packs in satellites. It was a success.

NASA scientists found use for this technology in fabricating a thermal management package for battery compartments in the Earth Observing System (EOS) satellites, but it is also being used by the Agency for space radiator panels. Because it is light, simple to use, and economical, NASA will likely find other uses for this solder, just as outside of the Space Agency, this unique bond is finding many practical applications.

Partnership

Materials Resources International (MRi), of Lansdale, Pennsylvania, teamed with researchers at Langley through a Phase II **Small Business Innovation Research (SBIR)** contract. MRi technologies and products center on materials, systems, and services for joining difficult-to-join materials, dissimilar metals, intermetallics, and ceramics to metals. The joining of such materials is a growing market with application in the electronics, aerospace, power-generation, automotive, chemical-processing, and process machinery industries.

MRi's work with the resulting technology, S-Bond active solder, was so successful, that in 2002, it created a second company devoted just to this work. **S-Bond Technologies LLC (SBT)** now handles the manufacturing and distribution of this product.

Product Outcome

Commercial development of S-Bond has been progressing for nearly 10 years with emerging applications in thermal management components for electrical packaging, lasers, high-power electronics, ceramics, graphite, carbides, armor, and many other general industrial



Pictured here are titanium sensor housings for down-hole drilling, with S-Bond-joined ceramic-metal seals on the viewing end of the sensor heads.

applications, including the joining of aluminum structures. The main focus of SBT, though, is on electronic packaging and thermal management.

Market potential for S-Bond is strongest as a metallic-joining compound that can bond most inorganic materials in an economic, low-temperature, one-step joining process. Market applications include the joining of thermal-management devices that require high-thermal conductivity, the joining of electronic packages that use new ceramics and composite materials, as well as a host of other joining applications where adhesives or conventional solders will not work.

S-Bond works at low temperatures, in air, without flux, and without metallization. It joins all metals, most ceramics, glasses, and metal matrix composites. It can be applied with a variety of methods, including brushing, ultrasonic bath, dipping, thermal spraying, foil or press, and friction transfer, to name a few. Combined with its use of low soldering temperatures, these methods of application make S-Bond very easy to work with. Temperatures for creating the bond can be so low that they can even be achieved with the use of induction, hotplate, or flame. Additionally, S-Bond alloys are lead-free, making them more environmentally acceptable than many traditional solders.

The technology has a growing market demand. From 1997 to 2004, the company has seen sales of over \$1 million, and it has emerging electronic packaging markets that hold the potential for sales of over \$10 million in the next 3 years.

S-Bond has also been used in space radiators that use carbon composite, graphic foam, and thermal graphite materials for thermal management. In addition, it has been used in circuit board heat transfer panels for cooling of satellites and high electrical density avionics, as well as providing pipe joining for satellite thermal control. It is also available for use in space structures where carbon composite and light metal joining is required. ❖

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