FAQs

FOIL

Q. How is NanoFoil® made?
A. NanoFoil® is made by vapor depositing thousands of alternating nanoscale layers of nickel and aluminum.

Q. What happens to the NanoFoil® once it is ignited?
A. The NanoFoil® undergoes a chemical reaction that results in the extremely stable intermetallic material, NiAl. The reacted product of the foil NiAl is often used in turbine blade coatings.

Q. How hot does the NanoFoil® get?
A. The peak temperature of the foil is approximately 1400°C, but it only reaches this temperature for milliseconds. The heating is localized to the solder layers and the component remains at room temperature during the entire process.

Q. Does the foil need some special atmosphere to work?
A. The foil does not need any special atmosphere for use. The energy in the foil is released by an intermixing reaction between the aluminum and nickel and does not need any additional constituents. The reaction can be done in vacuum and even under water or in outer space.

Q. Does the NanoFoil® alone make the bond or do you need solder?
A. The NanoFoil® alone will not create a bond without solder on either side. The foil can be thought of as a heat source used to melt the solder locally which replaces a hotplate or oven.

Q. What is the shelf life of the foil?
A. The foil is made of metallic material and does not degrade over time. We have regularly used foil that is over one year old with no degradation of performance.

Q. What are the shipping requiments for the foil?
A. Foil is classified as a 4.1 flammable solid. RNT is certified to ship the foil via air or ground.

BONDING PROCESS

Q. What materials can you bond?
A. We can bond virtually any target material including: pure metals, alloys, nitrides, oxides, carbides, silicon and graphite.

Q. What are the solders and what are their melting points?
A. The solders are Sn (tin) and SnAg (tin-silver) based solder which melts at approximately 220°C-232°C.

Q. Can other solder be used with NanoFoil®?
A. NanoFoil® is the heat source and virtually any solder can be used with the foil. RNT uses a special solder to wet ceramics without the need for a metallization layer. In order to wet to ceramics directly, we need to use this proprietary solder.

Q. How is the solder applied to the target and backing plate?
A. The solder is applied to both the target and backing plate on a hotplate using a proprietary process.

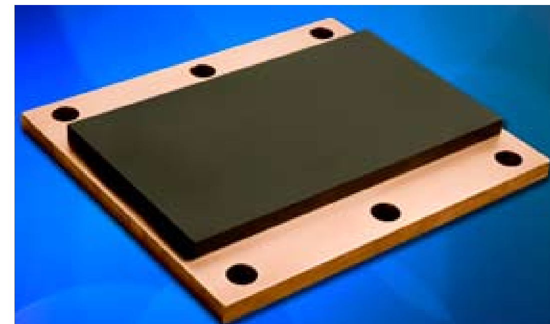
Q. For a large target, do you just use one large piece of NanoFoil®?
A. For large targets, the foil is made into an array, making the bond area it can cover virtually limitless.

Q. How do you ignite the foil?
A. The foil is ignited electrically at multiple points around the area of the target simultaneously.

Q. What are the flatness requirements for the components prior to bonding?
A. Typical flatness requirements are 0.001” - 0.002”/inch of travel. We have successfully bonded targets over one meter square.

Q. What pressure is applied during bonding?
A. Typically, 50 - 150 psi is applied to the target during bonding. This ensures good thermal contact between the foil and solder and also forces air out while the solder is molten, providing a nearly void-free bond.

Q. How large of a target can you bond?
A. The size of targets that can be bonded is not limited by the technology, but only by the press used to apply pressure during the bonding process. We have bonded targets up to 2.5 meters long and at this point are not aware of any limitation on the size of the bond.



FAQs

PERFORMANCE OF THE BOND

Q. What are the advantages of using NanoBond®?
A. There are several advantages to using the NanoBond® process. Among them are:

- Ability to substitute indium/polymer bond with higher melting temperature solder using NanoBond®.
- Sputter rate increased by 40% to 100% due to ability to withstand higher temperature.
- Higher strength (3X - 4X compared to indium) leads to better reliability.
- Significantly better electrical and thermal performance compared to polymer bonds leads to higher rates and cooler targets.
- Significantly lower residual stress and deflection on components.
- Minimal driving force for debonding of assembly during operation.
- Improved bond line thickness control, target flatness control compared to conventional process.
- Higher yield, throughput during bonding.
- Freedom in the choice of backing plate and solder.

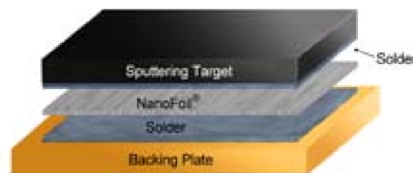
Q. What is the quality of the bond? Does it compare to other bonds?
A. The quality of the bond has been proven by multiple customers to be equivalent to or better than traditional indium bonded or polymer bonded targets. The melting point of the solder in NanoBond® is about 70°C higher than the indium solder. This enables the bonded assembly to be run at higher powers than assemblies bonded with indium.

Q. What is the thermal conductivity of the bond?
A. The typical thermal conductivity of the bond is between 30-40W/mK.

Q. How thick is the interface?
A. The interface thickness or bond line thickness (BLT) is typically .015”-.020”. We can make the bond line thicker if the application requires a thicker bond line.

Q. What are the bond strengths?
A. The bond shear strength is typically determined by the strength of the solder used. The typical shear bond strength of Sn and SnAg solders we use are in the range of 25-30 MPa.

Q. What is the bond coverage?
A. Typical bond coverage is over 97% - 99%.



Q. Will my targets still crack during use?
A. During use the targets are still subject to thermal stresses caused by the coefficient of thermal expansion mismatch between the target and backing plate. However, because the target has been bonded at room temperature, the target is not starting with any residual stresses making it less likely to crack prematurely.

Used silicon sputter target, bonded with NanoBond® process.

Q. Does it outgas at high vacuum?
A. The reacted product of the foil is a very stable intermetallic material that melts at over 1600°C. The intermetallic material is incorporated in the bond and does not outgas during high vacuum use. Multiple customers and equipment makers (AMAT, NEXX) have tested the bond in their systems and have certified it for use.

Q. Does the bond accommodate thermal stresses during use like indium does?
A. In general the solder used is more rigid than indium and does not relax or flex as much as indium. However, because the target has been bonded at room temperature , the target does not start with high residual stresses making it less likely to crack or debond prematurely.

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