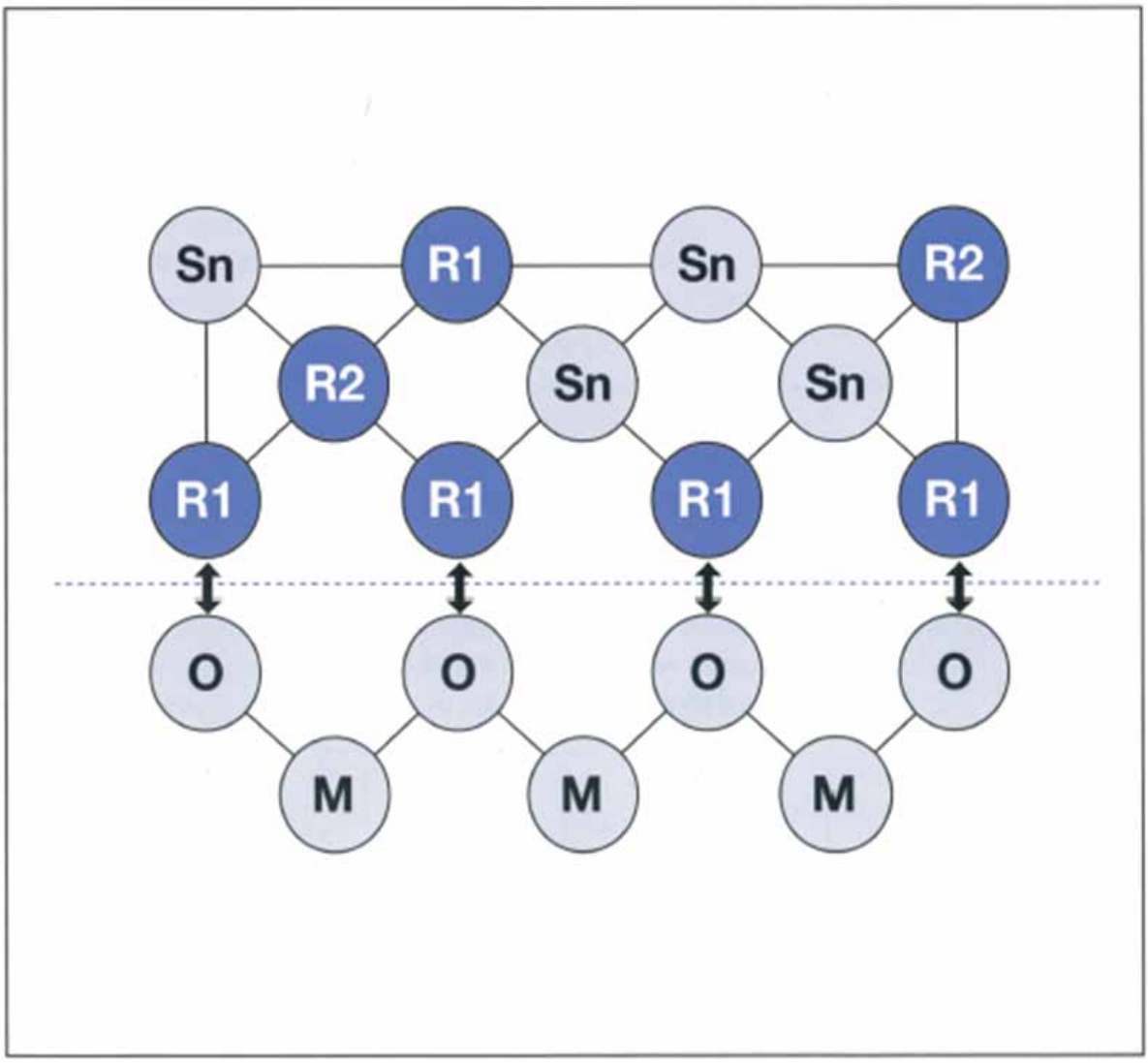
CERASOLZER®
CERASOLZER®·ECO

Glass, Ceramics, & Low Solderability Metals

Bonding Use Metal Solder

CERASOLZER® CERASOLZER®·ECO (Pb-Free)



Soul in Technology
KURODA TECHNO CO.,Ltd.

Cerasolzer® is a metal solder for direct bond to glass and ceramics.

The applications of Cerasolser are limitless. Cerasolzer has advantages that cannot be offered by the conventional silver paste firing, indium soldering, Mo-Mn method, deposition, sputtering, etc. It is a unique material that can significantly contribute to cost reduction and simplify processes.

Kuroda Techno has been conducting research and development of not only materials but also technology and devices required for bonding, which we provide as the Cerasolzer technology.

Furthermore, Kuroda Techno is continuously trying to develop peripheral technologies for Cerasolzer bonding, new kinds of Cerasolzer alloys as well as other special solders in order to increase the range of applications.

Cerasolzer®: Pb-Sn based solder with additional metal elements

<Components of Cerasolzer>

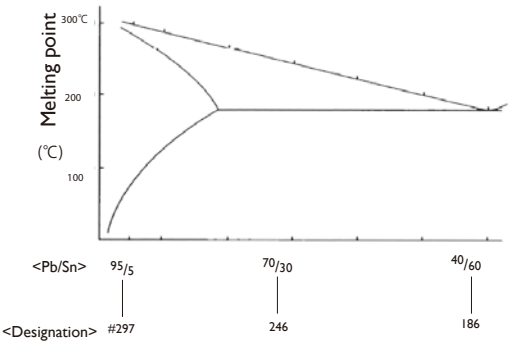


Fig.1 Phase diagram of Pb-Sn system and melting pionts

Cerasolzer has almost the same mechanical, electrical and chemical characteristics as general solders. Its most common components are Pb-Sn alloy, Zn, Sb, Al, Ti, Si and Cu. In order to form a uniform alloy without separating those additional elements, they are melted in a special way. Furthermore, we are developing Cerasolzer designed for special applications, available in different shapes, such as a wire, bar, thread or ribbon, Cerasolzer can be molded into other special shapes in order to fit your application.

Cerasolzer®-Eco(Pb-Free): Sn-Zn based solder with additional metal elements

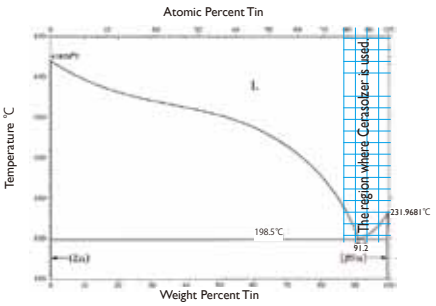


Fig.2 Phase diagram of Sn-Zn system

The components of Cerasolzer-Eco are Sn-Zn alloy with In, Sb, and Al.

What makes Cerasolzer® a material with execellent bonding abilities?

Glass and ceramics are composed of metal oxides. Additional elements in Cerasolzer combine with oxides and form strong bonds.

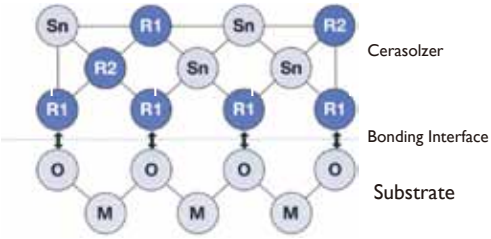


Fig.3 Interface between Cerasolzer and substrate

Oxygen is required for bonding. Element (R1) has a high oxygen affinity and is strongly combined with element (O).

Generally, (R1) is combined with oxygen in the atmosphere to form an oxide (O)-(R1). In the case of substrates, (R1) is combined with (O) or (O)-(M) in the substrate. Our soldering method utilizes this chemical bond with oxygen to create a strong bond with a substrate.

With no adhered organic or foreign particles on the substrate, bonding is done using ultrasonic energy and heat.

<Bonding Method of Cerasolzer>

As Cerasolzer can be directly bonded to an oxide, it requires no activation of the surface while general soldering does. For this reason, no flux is used for activation. Intervention of organic substances such as flux tends to have a bad effect on the chemical bond, making soldering impossible. Cerasolzer is soldered by the chemical bond at the bonding interface. To achieve this, chemical bonding is required in broad area on the surface of the substrate. Therefore, contamination must be eliminated on the bonding interface. Harmful factors include air layers (air bubbles), organic substances, foreign paticles, etc. Organic and foreign substances may be eliminated beforehand, but the air layer is not easy to eliminate. The most effective method to eliminate air layers involves "ultrasonic oscillations" which are capable of removing air layers at the interface in an extremely short time. In addition, bonding strength is enhanced by the ultrasonic energy. In the case of such bonding, Cerasolzer must be melted on the surface of the substrate, as is the case with soldering. In short, bonding is done using the ultrasonic energy and heat.

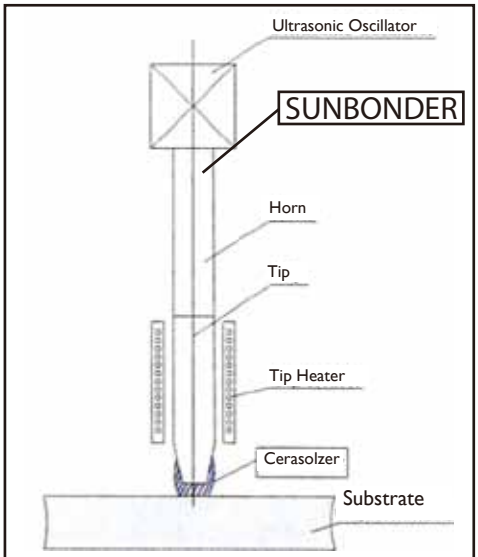


Fig.4 Principle of Cerasolzer bonding method

The ultrasonic oscillation frequency used for bonding is 10 to 100 kHz and the output power is 10 to 1,000W.

Although it may simply be said that Cerasolzer melts on the substrate, the conditions are actually determined by the heat capacity (heat conduction) of the substrate, bonding area and melting temperature of the Cerasolzer used. In order to melt Cerasolzer on the surface of the substrate, preheating is generally recommended. Preheating is required when the heat conductivity of the substrate is high, when the bonding area is very small, and when the substrate is damaged by the heat gradient. It is recommended to preheat at a lower temperature than at the melting point of the used Cerasolzer alloy. Contrary to preheating, it is also considered to increase the temperature of the iron, but this is not so desirable in terms of Cerasolzer's properties.

Notes for Bonding Cerasolzer®

There are three major bonding patterns.

<Bonding Pattern of Cerasolzer>

A Cerasolzer type and a bonding pattern are determined based on the function, structure and shape of the substrate. Additionally, bonding pattern can be also determined by the performance of Cerasolzer. There are three major bonding patterns of Cerasolzer.

I . ONE STEP BONDING

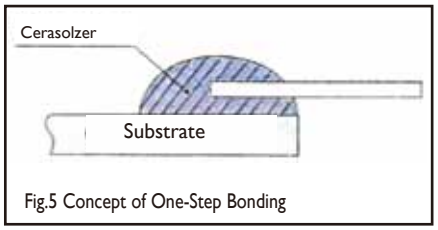


Fig.5 Concept of One-Step Bonding

This method directly bonds a lead wire, metal fitting, etc. to the substrate by using Cerasolzer. It creates two joints at the same time, i.e. Cerasolzer to the substrate, and Cerasolzer to the lead wire. The ultrasonic oscillations constantly penetrate the bonding area from the upper side as in Fig.4. If the lead wire shape is wide, the ultrasonic waves do not reach the substrate under the lead wire (shadow area), where eventually, soldering is not accomplished. In the case of a small size lead wire, good soldering is achieved.

II . TWO STEP BONDING

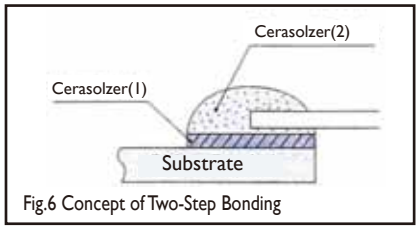


Fig.6 Concept of Two-Step Bonding

This method includes pre soldering as the first step to ensure proper bonding with substrate. The lead wire is already coated with Cerasolzer. Pre-soldered substrate with Cerasolzer(1) and a Cerasolzer coated component (lead wire etc.) are bonded by using ultrasonic oscillations, heat and more Cerasolzer(2).

The two step method offers a slight variation where a Cerasolzer coated component is thermally pressed onto the pre-soldered substrate.

III . DIPPING

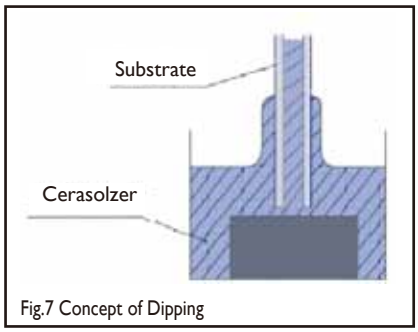


Fig.7 Concept of Dipping

This method applies an ultrasonic bath where Cerasolzer is melted in order to coat a larger area of shaped substrates. It is even possible to inject Cerasolzer into the inner cavity of the cylindrical substrate.

Necessity of approximating thermal expansion coefficients

When bonding two materials with Cerasolzer, the bonding temperature should be 200℃ to 300℃. If there is a difference in their thermal expansion coefficients, they may be distorted, resulting in reduced strength or rupture, when materials return to room temperature. It is ideal to adjust their difference in expansion within 10 x 10^{-7}/℃. It is also possible to take advantage of this phenomenon to intentionally utilize the difference in expansion.

Development and Quality

Cerasolzer is applicable to a wide range of materials, including glass and ceramics. Its field of applications is enormous.

<Application of Cerasolzer >

Cerasolzer is bondable to not only all types of glass and ceramics, but also to low solderability metals, such as Mo, Ti, Al, which have been conventionally difficult to solder. Cerasolzer's field of applications is practically limitless because of its unique ability to bond to a wide range of materials.

Application to Lead Wire Bonding

The electric or electronic parts always require electric signals to be fed into their active elements and extracted from them. Use of Cerasolzer allows lead wire to bond superior to conventional silver paste method, resin method and evaporation method. (Various displays, solar batteries, superconductive ceramics, film ICs, resistors, capacitors, quartz oscillators, and so on)

Application to Airtight Sealing

With the extremely high airtightness, Cerasolzer is capable of simplifying conventional complicated processes. (Vacuum tubes, vacuum systems, gas laser, high-voltage resistors, capacitors, and so on)

All possible tests have been conducted, assuming industrial requirements and standards for such products/parts.

<Characteristics of Cerasolzer >

The performance of Cerasolzer as a product/part bonded to the substrate by the ultrasonic energy and heat is very important. The value of Cerasolzer bonding can be realized only when it satisfies the requirements for temperature, humidity, atmosphere and application of the product/part. In order to satisfy such a variety of requirements, many tests have been conducted on the Cerasolzer material as well as its bonding and peripheral technology in order to comply with most of the inductry standards.

Heat Resistance

Heat resistance of Cerasolzer is determined by its melting point. Cerasolzer #297 can endure up to approx. 250℃ in a stress-free state. Other composition types of Cerasolzer can also endure the temperature by 30℃ to 50℃ lower than their melting points. If a stress is applied, heat resistance differs depending on the degree of stress. Generally the lowest temperature required is -60℃ and Cerasolzer fully satisfies this requirement.

Humidity Resistance

Generally required humidity resistance is 90%RH to 95%RH at 60℃, or 85%RH at 85℃ and Cerasolzer is capable of satisfying this requirement. A special element has been added to Cerasolzer in order to enhance humidity resistance. When developing the material, we choose only those showing no abnormality in boiling water.

Temperature Cycling Test

A temperature cycling test is conducted to know whether or not the performance of a product/part will deteriorate in the entire temperature range where product/part will be used. Its temperature difference ranges from 100℃ to 180℃, but Cerasolzer can fully endure a more severe temperature cycling test combined with a humidity test.

Cerasolzer®
Bonding Machine

Bonding Strength

Cerasolzer's bonding strength differs depending on its composition. Cerasolzer #297, the most typical of all, has the highest bonding strength. The bonding strength is generally reduced as the melting point becomes lower. This is because the bonding strength seems to be affected by the magnitude of residual strain after bonding, depending on the material components. It has been discovered as a very interesting phenomenon that as a post-bonding time passes, Cerasolzer's residual strain tends to be eliminated, increasing its bonding strength.

Special purpose machine and novel technology: It is ideal to progressively approach both hardware and software.

<Cerasolzer Bonding Machine>

A special-purpose machine is required to bond Cerasolzer and substrates. In the case of switching to a different Cerasolzer alloy, the same oscillation system can be used after a proper software set-up is performed. The ultrasonic oscillation system is the basis of the machine and its peripheral mechanisms play an important role in a Cerasolzer bonding process. Based on this technology's uniqueness, machinery and peripheral equipment developed solely for Cerasolzer must be used. Cerasolzer bonding machines are sorted into two basic categories; so-called experimental machines capable of various bonding experiments to check their performance: and production machines capable of actual production. The machines beyond the specifications of general-purpose machines will be manufactured as special-purpose ones.

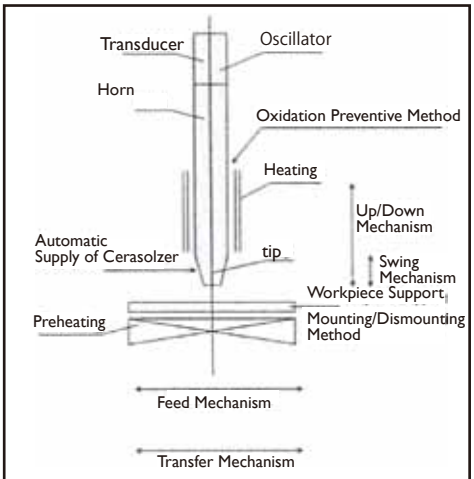


Fig.8.Required mechanism of Cerasolzer Bonding Machine

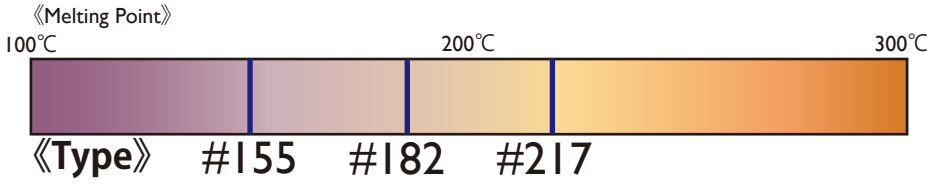
<Peripheral Equipment and Advancement of Cerasolzer>

Implementation of Cerasolzer technology requires development of a very specific peripheral equipment and continual research, and development of Cerasolzer bonding in general. Many technologies originating from Cerasolzer have been developed and are being applied to a wide range of applications.

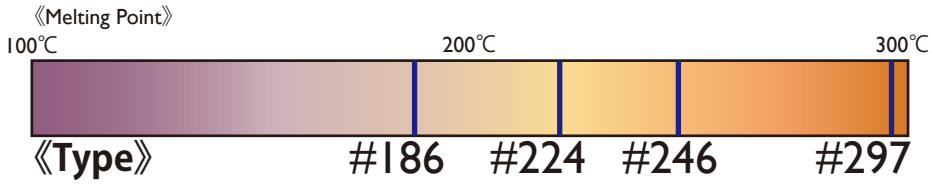
Types of Cerasolzer® and Cerasolzer®-Eco

For the Future

Cerasolzer®・Eco (Pb-free)



Cerasolzer®



Cerasolzer can solder the materials below

Glass & Ceramics

- Soda lime glass
- Borosilicate glass
- Quartz glass
- Lead glass
- Pyrex
- Vycor
- Optical glass
- Liquid crystal glass

- Alumina
- Zirconia
- Silica
- Titania
- Beryllia
- Magnesia
- Mullite
- Forsterite
- Enamel
- Mica
- Ceramics

- Magnetic material
- Dielectric material
- Resistant material
- Heating material
- Ultrahard material
- Heat resisting material

Metals

- Silicon (Si)
- Germanium (Ge)
- Aluminum (Al)
- Titanium (Ti)
- Tantalum (Ta)
- Niobium (Nb)
- Tungsten (W)
- Molybdenum (Mo)
- Ruthenium (Ru)
- Zirconium (Zr)
- Beryllium (Be)
- Chromium (Cr)
- Gold (Au)
- Silver (Ag)
- Copper (Cu)
- Nickel (Ni)
- Zinc (Zn)
- Lead (Pb)
- Tin (Sn)
- Stainless Steel
- Kovar
- Inconel
- Nichrome
- Aluminum Alloy
- Copper Alloy
- Nickel Alloy
- Titanium Alloy

Miscellaneous

- Conductive printing paste (Ag,Cu Paste)
- Conductive glass (SnO_2,In_2O_3)
- Transparent Conductive Oxide (ZnO,ITO,FTO,TO,ATO,GZO,GIT)

- Sintered Metal
- Magnetic Metal
- Semiconductor Material

We will continue to develop overall know-how not simply as "Cerasolzer," but as "Cerasolzer Technology"

As you discover more about Cerasolzer's properties, bonding methods and performance, you will notice the uniqueness of the Cerasolzer Technology. When you include special peripheral systems and our bonding know-how, Cerasolzer potential extends limitlessly. After released in the market, its excellent performance has been increasingly highly evaluated in different fields. We are making every possible effort to further improve our technology with ultrasonic soldering system "SUNBONDER", along with extending the range of its applications.

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