## Soldering is now possible even on glass and ceramic materials with "Ultrasonic Wave Soldering"

Until now, soldering was basically a process for joining solder and metals. Ultrasonic wave soldering is a technique which enables the soldering processes to be used for joining solder to glass, ceramics, and other non-metal materials. In recent years, as the movement toward natural energy sources is progressing worldwide, this ultrasonic soldering is being used in many applications, such as for attaching electrodes to solar panels.

In this edition, we will take a closer look at this ultrasonic soldering technology, and examine the ways in which it is expanding the possibilities of soldering.

### 【 A technique that ignores conventional wisdom. Ultrasonic for applying solder to oxide materials】

The technology of ultrasonic wave soldering enables the application of solder to materials such as glass, ceramics, and anodized aluminum, which cannot be used with conventional soldering. Typically when doing soldering, it is standard procedure to first remove oxides from the surface of the material to be soldered. However, the materials used in ultrasonic soldering (glass, ceramic) are themselves oxides. These materials are joined with solder using different principles than in traditional soldering. Also, the use of flux is required in traditional soldering, but ultrasonic soldering is possible even without the use of flux.

### 【Ultrasonic “Caviation” Effects】

When ultrasonic vibrations are applied to a liquid, the differences in amplitude pressure create small cavities in the form of air bubbles. This phenomenon is called “cavitation”, and at the time when these cavities are crushed by atmospheric pressure, a large amount of energy is released. It is said that the lifespan of these cavities is a mere 1/50,000 of a second, and ultrasonic soldering makes use of the instantaneous energy release from this cavitation process.

The ultrasonic soldering system consists of a heater with an iron tip that supplies ultrasonic vibrations at 60 KHz during its soldering. The waves are transmitted to the iron tip through the medium of the phon ultrasonic waves produced by the oscillator's vibrations. In the boundary between the base material and the melting solder, a hollow cavity (foam) forms as a result of the cavitation effect.

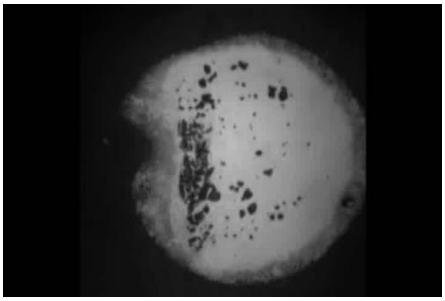

*Figure 1. Confirming the existence of the cavitation effects*

**【 Principles of Bonding between Metals: Intermetallic Compound Formation】**

For aluminum, stainless steel, and other metals, soldering is in no way impossible. In the traditional method, soldering is performed using special flux to remove the firm layer of oxidation. However, as a result of recent environmental regulations, e.g. RoHS, the use of highly acidic flux materials must be avoided. This has led to a focus on new ultrasonic soldering techniques, which can be performed flux-free. Ultrasonic soldering uses the energy released from the rupture of hollow spots through the process of cavitation to replace the function of the flux, removing the oxidation layer. What this means is that the result after the removal of this oxidation layer is the formation of a reaction layer, just as in traditional soldering.

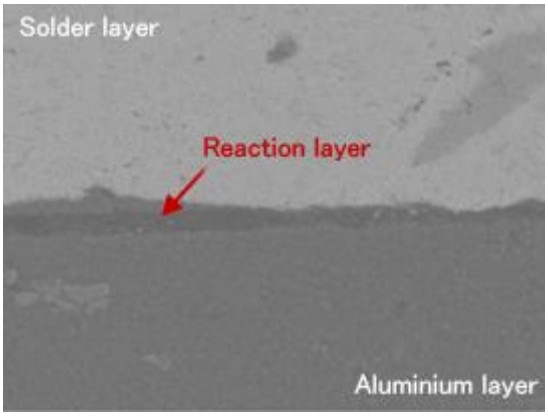


*Figure 2: Reaction layer between aluminum and solder (6,000x)*

**【Principles of Bonding between Non-metals: Covalent Bonding with Oxygen】**

On the other hand, in the case of glass and ceramics, when the base materials themselves are oxides, the energy released from cavitation cannot remove the oxidation layer. In this case, using the energy from the cavitation rupturing, the layers of air, organic matter, and other foreign materials are removed from the bonding surface. After that, the vacuum effect forms a hollow cavity, and through the intermediary of oxygen captured from the atmosphere, the oxide that is the base material and the metallic elements of the solder form a covalent bond. At this point, the soldering process is complete. This is why when working with non-metal base materials, there is no reaction layer forming a boundary between the base material and the solder.

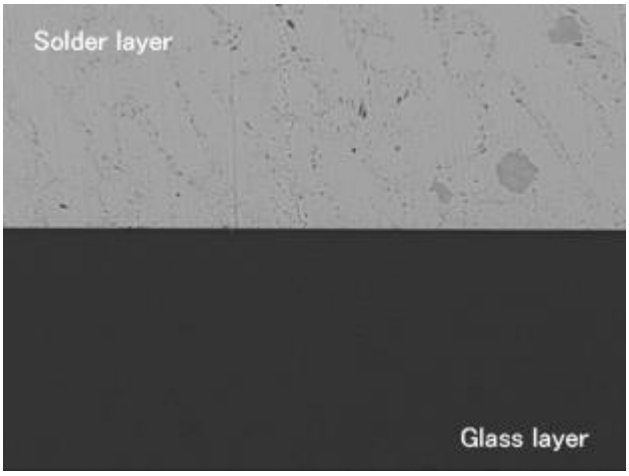


*Figure 3: Border of glass and solder (3,000x)*

In this way, although the bonding principles differ, ultrasonic wave soldering has made previously impossible soldering applications a reality.

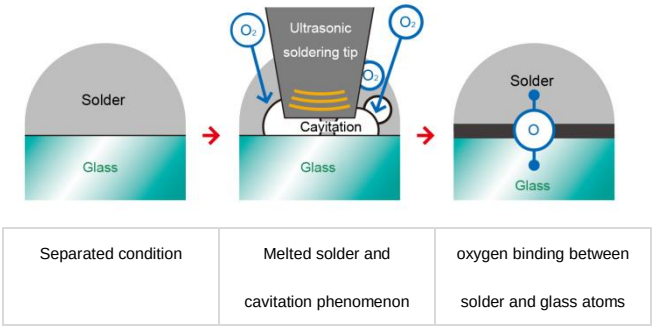


Figure 4: Principles of bonding for solder and glass

## 【Expanding Applications of Ultrasonic Wave Soldering: Solar Panels, Motors, Aircraft, etc.】

With uses such as application of electrodes to glass surfaces for use in solar panels, this technology is also showing great promise for use with materials such as aluminum and ceramics. MCU units, which are the brain systems of motor vehicles, are stored-in a housing with an aluminum interior in order to isolate them from external noise, and soldering is sometimes performed through ultrasonic technology for these cabinets. In recent years, more and more motor coils and transformers are being made with aluminum cable instead of copper to reduce weight and production costs. This is also true of aircraft gauges, and ultrasonic soldering plays an active role in the production of these systems as well.

Up until now, soldering was mainly performed using low-power tools. However, as a result of new technological developments such as ultrasonic and laser soldering, the scope of soldering has expanded to everything from small and detailed work to high power large scale projects, as well as materials which were previously unusable such as glass. At Japan Unix, we possess a wealth of information regarding all kinds of soldering techniques encompassing the basics of iron soldering as well as laser and ultrasonic wave techniques, and are also carrying out streamlining and automation processes through the use of specialized robots. If you have any problems related to soldering, please contact our company.

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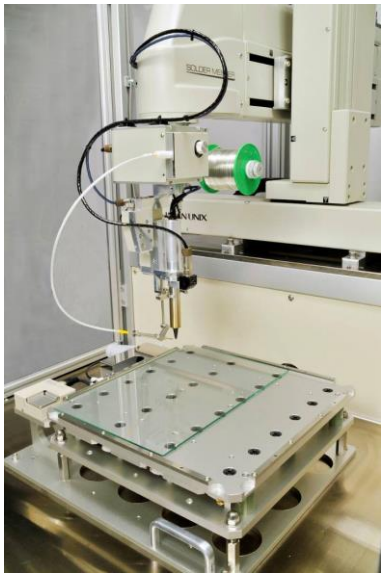
## 【Ultrasonic Wave Soldering Systems】

Ultrasonic Soldering Iron: UNISONIK



A UNIX 700S with an ultrasonic soldering unit installed

**Youtube: Ultrasonic Wave Soldering Robot**

http://youtu.be/8BjhvtHRLxA