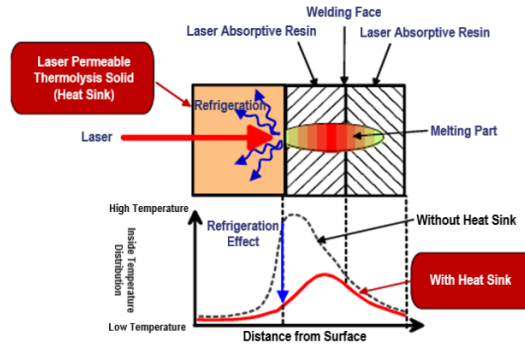




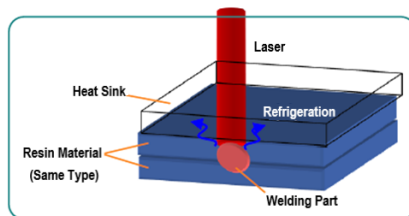
Name of Theme	Precise bonding equipment for electronic devices utilizing heat sink laser welding
Name of Organization	Seiwa Optical Co.,Ltd.
Technology Field	Manufacturing
Overview	
<p>Although electronic devices and medical apparatuses require precise bonding technology for infinitesimals like micro switch or encapsulated bonding for large acreage objects like flat panel display, there are issues of influence by heat and insufficient accuracy for the products in the conventional boding methods under practical application.</p> <p>The newly developed precise bonding equipment for electronic devices can solve those issues and realize welding by the surface refrigeration inside melting method using high-speed and high-performance laser in order to meet each need and each size.</p> <p>This technology is the result of Adaptable and Seamless Technology Transfer Program (A-STEP) implemented by Japan Science and Technology Agency (JST) applying no-surface-damage laser welding method developed by the Advanced Laser Resin Welding Technology・Promotion Consortium.</p>	
Skelton Diagram	



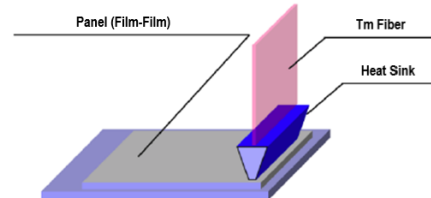
Precise bonding equipment for electronic devices utilizing heat sink laser welding



Principle of Surface Refrigeration Inside Melting Technology



Welding Infinitesimal Precision Parts such as Electronic Components, Micro Circuits



Encapsulated Bonding for Large Acreage Objects like Flat Panel Display

- Possible encapsulated welding without heat influence
- No heat damage on laser radiation surface
- Realize welding line of less than 1mm width
- Possible welding for high-melting-point fluorine resin

Background

Various electronic devices like an information terminal require small size, light weight, high performance, thermoduric and toughness against an impact from outside and the integration level of circuits has been increasing. For example, mounted devices such as microchips and optimal sensors have a high demand for laser welding of “contamination-less, flux-less, refinement” in the assembling process.

Also, almost all the electronic devices are precise parts, the demand for laser welding equipment is much higher than that for supersonic welding equipment which causes dusts and machinery oscillations in other fields. There is a demand for joining objects in the line of “submillimeter (less than 1mm) depth. Micro flow channel cell can compose a device which is suitable for various objectives by setting up functional fields such as response fields in which reagents are placed along the flow channel with diameter from a few μm to several hundred μm .

The usage objectives are representatively gene analysis, clinical diagnosis, drug



screening in the fields such as chemical science, biology, pharmaceutical science, medical science, veterinarian, or synthesis of chemical compound, environment measurement. In addition to medical treatment, preventive measure is becoming more important and it's required to enable easy physiological examination at home and on-site measurement for toxic substance. For realizing them, welding scan technology is desired at high variance.

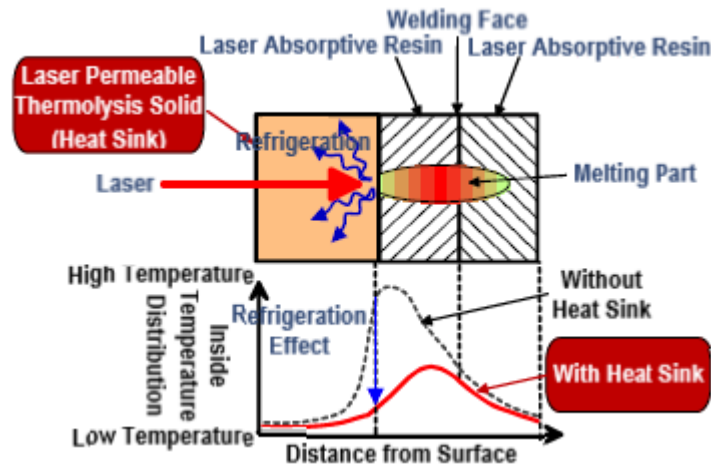
On the other hand, high level encapsulation technology is required to prevent degradation by protecting devices from humidity and oxygen in organic EL (electro luminescence) panel for which screen acreage is becoming larger. Since encapsulation by currently popular sealant can't prevent invasion of humidity and oxygen sufficiently, more steady method is required. Also, since EL panel and liquid crystal panel require flexibility, thin-down and weight reduction, the basic material has been changed from glass to resin. Therefore, highly reliable bonding technology is required for joining resin film materials and, moreover, new method is required to bond longer encapsulated edge line at higher speed in terms of productivity.

Technical Content

The basic technology for this newly developed product is flux for surface refrigeration inside melting by laser radiation using infrared ray permeable heat-radiating solid (sink heat) which can realize both surface refrigeration and inside melting at the same time.

This technology is that the laser permeable heat sink, which is placed on the laser radiation target point on resin material to be melted, can penetrate laser ray into the resin material and realize inside melting preventing increase of temperature on the surface of material by radiating extra heat occurred in the resin.

In principle, this technology can be applied to all the heat plastic resins which absorb infrared ray. Since this basic technology can heat the target point by infrared ray permeability as the nature of resin, it's possible to bond transparent parts of materials directly and also to prevent deformation on the laser radiation face, therefore, it realizes encapsulated bonding even for thin, transparent and colored sheets keeping the flatness.



Principle of Surface Refrigeration Inside Melting Technology

There are 2 key points in this development. ①Laser welding along the line of 0.5mm width for precise electronic parts / micro flow channel ②One-shot welding along the line of 60mm length for encapsulated bonding on flat panel. We completed the welding machine which can realize 「narrowed down welding」 and 「long length beam」 together with 「surface refrigeration inside melting technology」 as mentioned previously, also utilizing the optical design technology which has been grown for many years. We can provide unique and singular products for welding and bonding 「transparent sheets without heat damage」 implemented by 「surface refrigeration inside melting technology」, which no other entities can provide.

①Laser welding along the line of 0.5mm width for precise electronic parts / micro flow channel

Commercially available light focusing lens is used for making a small spot diameter to realize laser welding along the line of 0.5mm width. However, if the material is resin, the light focusing lens causes a hole burned and melted by high energy concentration when laser is radiated. This technology can realize laser welding along the line of 0.5mm width without heat damage due to integrated technologies of light focusing technology and heat radiation technology utilizing refrigeration effect of heat sink.

Under the following conditions, welding is available for engineering resin.

- 0.1mm - 1.0mm thickness of resin to be welded
- Laser welding along the line of 0.5mm
- 25mm/sec processing speed (in case of PPS material)
- 10mm/sec processing speed (in case of COP material)



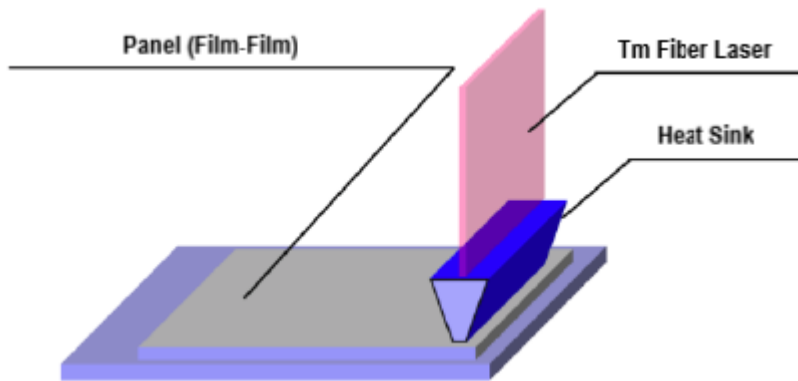
Major Engineering Resins used for Electronic Parts

Name of Materials		Melting Point (°C)
PA	Polyamide	222
POM	Polyacetal	165
PBT	Polypylene terephthalate	225
PPS	Polyphenylene sulfide	275

Major Engineering Resins used for Package

Name of Materials		Heat Bending Temperature (°C)
PS	Polystyrene	90 - 104
PMMA	Acrylic	65 - 95
PC	Polycarbonate	120 - 140
COP	Cycloolefin Copolymer	120 - 160

② One-shot welding along the line of 60mm length for flat panel encapsulated bonding
We developed a new method to realize flat panel encapsulation. The new method can weld and bond target materials at the aimed position one time by radiating rectangle Tm fiber laser beam through heat sink and compressing the work by heat sink (refer to the following diagram)



We realized the followings.

- 0.5mm or less width of welding line
- 0.5mm or less accuracy of welding position
- Also 0.5Mpa or higher airtight encapsulation proof pressure

Strengths of This New Technology and Know-how (Innovation, Superiority, Utility)

< Comparison between surface refrigeration inside melting technology and conventional technology >

There are many methods for joining multiple plastic materials such as heat plate, hot blast joint, oscillation welding as the limited methods only to heat welding by melting and bonding joint face of materials. Since those methods are not a technology to weld aiming the narrowed down target, it's difficult to apply them to small and precise parts. Especially, temperature control is essential for materials which easily get heat damages on the surface and affected gasification, but those methods are inferior for the temperature control. Then heating by laser is expected as a solution, however, in case of high energy concentrated laser (i.e. infrared laser ray with long wavelength generated by CO₂), the



temperature increase on the radiated surface of material is very fast and causes terrible damage getting melt-down or gasification instantly. On the other hand, in case of welding method using semiconductor laser, which is becoming popular, there is a requirement for coloring the materials on the other side to absorb the laser ray and it's impossible to bond the same kind of materials. (Refer to diagram No.1)

Our new development, the laser resin welding technology using infrared ray permeable heat-radiating solid (sink heat) can realize both surface refrigeration and inside melting to solve the above issues.

Comparison between new technology of surface refrigeration / inside welding and conventional technologies

	New Technology	Conventional Technologies			
	Heat Sink Laser Welding	Laser Welding	Laser Welding	Supersonic Welding	Heat Plate Welding
		*Mid-long range infrared laser is directly radiated to resin. No heat sink	*Infrared laser with combination of permeable material and absorbing material No heat sink		
High melting point resin (fluorine resin)	⊙	△	△	×	×
Heat damage for product	⊙	×	○	△	△
Flash and dust	○-⊙	×	○	×	×
Others	Laser absorbing agent is not needed	Laser absorbing agent is not needed	Laser absorbing agent is needed		

<Comparison for precise electronic parts between micro flow channel welding technology and conventional technologies>

In case of usual laser welding, the diameter of beam spot from laser generator is about 2-4mm, then we need to create a spot diameter by selecting a relevant light focus lens with focus distance which can cover the allowable range of distance from the work in process. Therefore, commercially available laser can't be used for narrowed down laser welding. Also, when laser is radiated to small spot, the energy concentration becomes very high and it makes a hole on the resin by burning and belting. It's not easy to execute precise joint by laser. In this new technology, heat sink realizes refrigeration effect and



the integrated technology combining light focus technology and heat radiation technology can realize welding along the line of 0.5mm width.

< Comparison for encapsulated welding between new technology and conventional technology >

For organic EL panel, high level encapsulation technology is required to protect the devices from water and oxygen as well as to prevent degradation. Currently encapsulation with popular seal agent can't prevent invasion of water and oxygen, therefore, more steady method is desired. As introduced here this time, the surface refrigeration inside melting technology is a new laser welding technology which can realize highly reliable joint technology for resins. High airtightness, no invasion of water and oxygen and flexibility improvement.

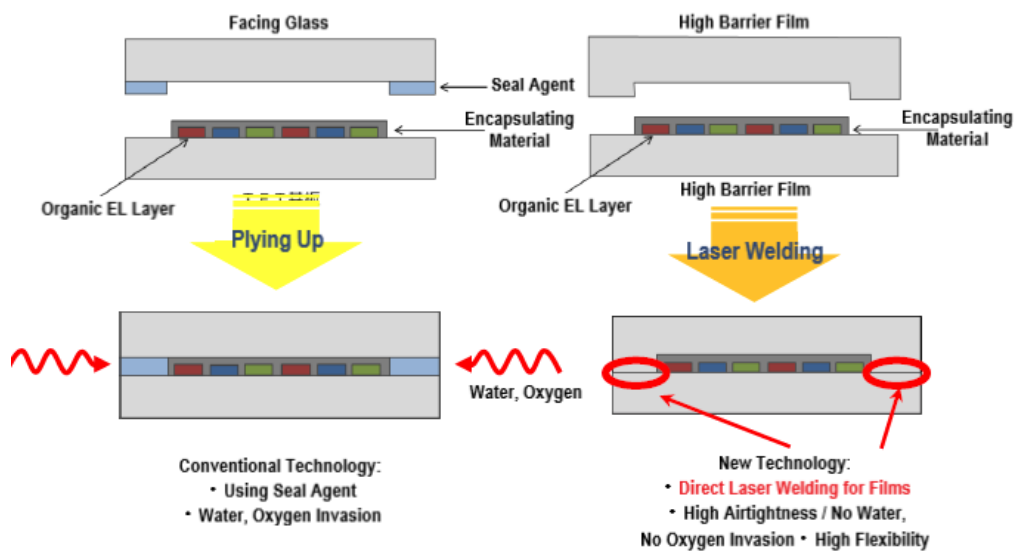


Image of Allied Company

We hope to establish alliances with companies which are interested in processing technology using our equipment.

- Department which is studying to improve joint of precise electronic parts, genetic analysis, micro cell flow channel for clinical diagnostic.
- Department of Production Technology which is studying to improve mass-production process for flat panel, and quality control.

Utilization of This Technology and Know-how (Images)

○Parts with encapsulation along the welding line of depth less than 1mm (switch, sensor, connecter, etc.)



<ul style="list-style-type: none">○ Formation of free way on micro flow channel by layered transparent sheets.○ Speed up of panel encapsulation process for smartphone
Process to Utilize This Technology and Know-how
<p>If you are in this technology, please feel free to contact us.</p>
Description of Terminologies
<p>【infrared ray permeable heat-radiating solid (sink heat)】</p> <p>When laser is radiated to resin, quick temperature increase occurs since heat transfer is very small under the exposure in the air. It causes a phenomenon of vaporization babbling exceeding melting. On the other hand, heat sink is a heat radiation panel which can prevent temperature increase by taking heat out from the surface of resin due to thermal conduction. It's an infrared ray permeable material made of glass or metal property.</p>