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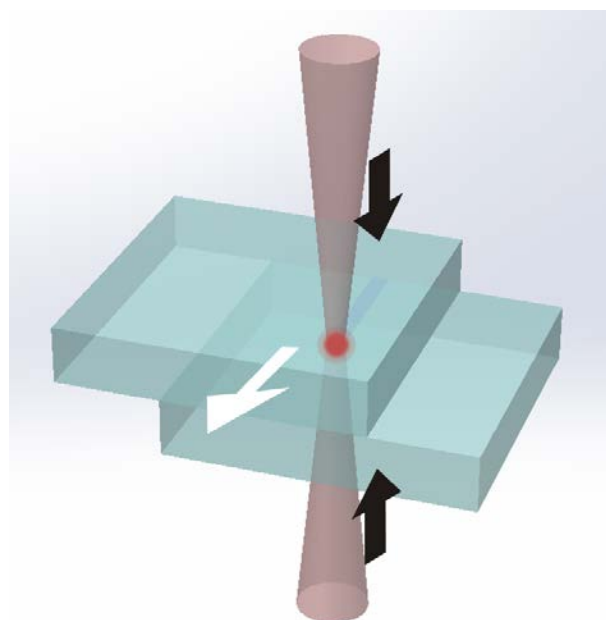
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Transparent Laser Plastic Welding – Clear Polymer Bonding for Medical Devices

A break-through in laser plastic welding technology has opened new doors for bonding of transparent polymers. This is great news for the medical device industry, which already benefits from the clean, precise and relatively error free process of traditional laser welding, now with even fewer restrictions.

Traditional laser plastic welding, also known as through-transmission laser welding, was introduced commercially over a decade ago. It found heavy adoption in the automotive industry for bonding under hood components where most applications were black or part color had little influence. However, until now, bonding two clear polymers was difficult and expensive, requiring specialized clear, IR absorbing additives.



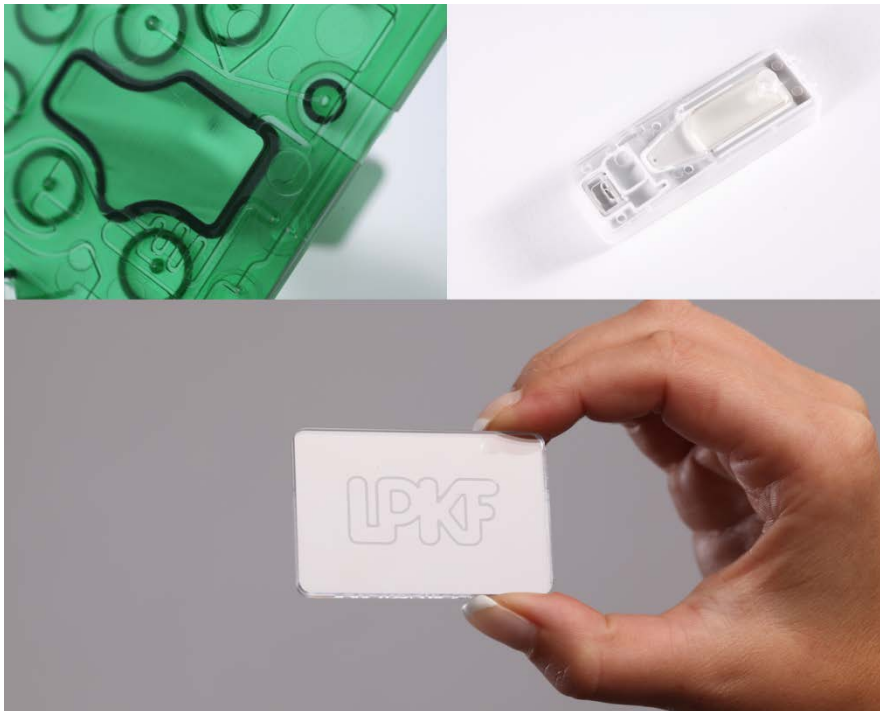
Transparent Laser Plastic Welding process diagram

Transparent laser plastic welding (TLPW) makes use of fiber laser technology, originally developed for the telecommunications industry, which allows for the output of much higher laser wavelengths, wavelengths that were previously unrealized.

Whereas a traditional IR laser will in most cases completely transmit its energy, a high-wavelength fiber laser is more readily absorbed by thermoplastics. This means that although much of the energy from the fiber laser passes through the joint, a good amount of it is volumetrically absorbed by both the upper and lower part. There is no longer a need to modify the plastics to absorb laser radiation.

A Medical Focus

Even before fiber laser technology, traditional laser plastic welding had, and will continue to offer, a lot of flexibility to the medical device industry. Applications such as micro-fluidic devices, catheters and fluid control devices benefit from the precision, cleanliness and surgical nature that laser plastic welding offers. Couple these advantages with the fact that transparent polymers can now be bonded free of additives and medical device designers have good reason to rejoice.



TLPW applications

There is little doubt that the largest growth market for TLPW will be the medical industry. Besides the obvious fact that many medical devices require clear-to-clear bonds, no extra additives or colors are required for the process to be effective. In other words, plastics in their natural, un-modified states can be bonded with all of the past advantages of laser plastic welding. This means there are no extra variables that could potentially change the biocompatibility of the plastic, making the FDA testing and acceptance process of a device much less painful.

Flexible Polymers

Making medical devices with PVC-free materials has become a major trend in the industry. Many manufacturers are looking to replace PVC with thermoplastic elastomers, a polymer with similar characteristics to but less environmental impact and potential toxic exposure than PVC.

Not only are thermoplastic elastomers weldable with TLPW, but the process handles them very effectively. “Strong bonds can be created quickly and with very little energy input in most thermoplastics rigid or flexible, but it is worth noting we have seen excellent results with TPU, TPE and TPO parts,” stated Dax Hamilton, Laser Welding Sales Manager of LPKF Laser & Electronics. “There is also minimal distortion, the welds are consistent and clean.”

All rigid thermoplastics are weldable as well, with common medical plastics including PMMA, polycarbonate and PVC, PS, COP, ECT. Tests have even been completed successfully on polymer membranes and white polymer-based fabrics as well.

Expanding the scope of laser welding

Welding transparent polymers without additives is in and of itself a great leap forward for laser processing of plastics, but the technology also brings other possibilities to the table. Because of the flexibility of the laser entry, having the option to bring the laser to the joint from either side, designers will have fewer restrictions when designing parts for laser welding. Also, butt joints are difficult to weld with traditional laser welding, but are much easier and effective with TLPW.

“Transparent Laser Plastic Welding will certainly not replace traditional through-transmission laser welding, but it will greatly expand the options and capabilities of the technology,” said Dax Hamilton after asked how TLPW would affect the landscape for laser plastic welding in general.

Applications lab

“The majority of applications we have seen come in to our application lab are either perfect candidates for transparent laser welding or have potential to be modified for use with this technology,” said Hamilton. Between the West Coast application lab located outside of Portland, Oregon and the LPKF application center in Erlangen, Germany, the company is equipped to handle testing and feasibility of both traditional laser plastic welding as well as TLPW.

“Although this technology is new, there are many parallels between TLPW and regular through-transmission welding. Our experience with traditional laser welding has a lot of carry over, and we feel that has put us in a position of knowledge leadership with this new technology,” said Hamilton.

LPKF Laser & Electronics has been providing commercial laser plastic welding solutions for the medical, automotive and commercial industries since 2000 after partnering with the Fraunhofer Institute in Germany on some of the first ever laser plastic welding research.

By Josh Brown

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