



## TRANSMISSION WELDING OF INFUSION TUBES WITH NIR-HIGH-POWER DIODE LASERS

### Task

Laser welding of polymers is characterized by targeted and contactless energy input. In addition, the process is free of dirt and particles and hence suitable for welding medical components. For such parts, however, transparency is often required, which usually cannot be ensured when conventional transmission welding is used. The reason is that an absorber has to be employed to deposit the beam energy into the joining plane, which has prevented transmission welding from being used on medical components to date. As an example, Figure 4 presents an application where the tube end of an infusion tube and a tube nipple, both consisting of additive-free polypropylene (PP), needed to be welded together.

### Method

In the near infrared range, the majority of polymers have characteristic absorption bands at wavelengths above 1.2  $\mu\text{m}$ . By selecting a beam source with a suitable wavelength, researchers at the Fraunhofer ILT have been able to exploit these bands in order to allow welding without using absorbers. In the absence of an absorber, both joining partners have equal optical properties; hence the laser radiation is no longer absorbed at their interface. Nevertheless, to deposit the beam energy into the joining plane, optics with a high numerical aperture (NA) is used (Figure 3). In the focal area the focused beam has the highest intensity, which is set to a value sufficient to melt both joining partners at their interfaces. Outside the focal area, the material remains solid due to lower intensity of the beam.

### Result

The measurement of the optical properties reveals a sufficiently high intrinsic absorption of PP at 1.7  $\mu\text{m}$  wavelength. When a high-power diode laser was used emitting at this wavelength, both parts of the infusion tube could be welded together successfully in a process time of 10 s. The generated seam is invisible from the outside and characterized by high strength and media tightness.

### Applications

The process introduced here is mainly used for medical applications, which often require transparent components. It offers an advantage that costs for the absorber can be saved. In addition, in medical fields as well as in food packaging, the use of absorber is usually connected with costly and time-consuming approval procedures which can also be circumvented by omitting the absorber.

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3 *Welding of transparent polymers using optics with NA.*

4 *Infusion tube with tube nipples.*