
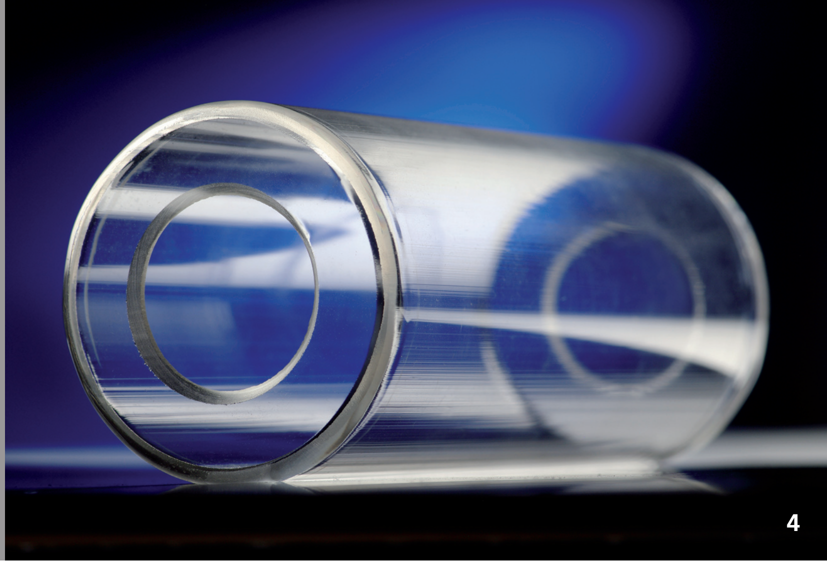


# WELDING OF SILICA GLASS WITH $CO_2$ LASERS

### Task

Conventional methods based on gas burner systems are still predominantly used to weld silica glass. But such processes are not very efficient because only a small amount of the radiant energy generated by the gas flame is actually used to melt the glass. Another disadvantage of this method is the large working area relative to the seam surface, which means that an additional processing stage is required to remove soot and other undesirable waste products. These drawbacks restrict the ability to develop an automated manufacturing process and, compared with laser welding, demand more work as well as reducing process repeatability. Instead of using a gas flame to heat the glass, more reliable results can be obtained if the glass is heated to the required processing temperature by means of a $CO_2$ laser source.

### Method and Result

The electromagnetic radiation of the $CO_2$ laser at a wavelength of 10.6 µm is absorbed by the surface of the component. Energy passes through the material at its most common thickness by way of thermal conduction. But unlike gas welding processes, there is no chemical interaction with the components to be joined. In the proposed method for laser welding of silica glass, the energy is applied homogenously and virtually simultaneously throughout the joining zone by repeatedly rotating the component and/or laser beam. A specially adapted exposure strategy suitable for any size of component currently enables fully welded joints to be produced in materials with a thickness of up to 3 mm with a minimum input of energy. This strategy combines a continuous feed mechanism that moves the laser beam along the length of the weld seam with a quasi-simultaneous superimposed exposure pattern.

### Applications

The process is suitable for applications in the pharmaceutical industry, such as the hermetic sealing of primary packaging for medicinal products, and in the manufacture of products with heat-sensitive functional coatings, e.g. UV light sources and sensor housings. It also holds promise as a substitute for certain flame-sealing processes commonly employed in the manufacture of chemical apparatus and lighting products.

### Contacts

Dipl.-Ing. (FH) Elmar Gehlen
Phone +49 241 8906-640
elmar.gehlen@ilt.fraunhofer.de

Dr. Alexander Olowinsky
Phone +49 241 8906-491
alexander.olowinsky@ilt.fraunhofer.de

*3 Sealed drug ampoules.*

*4 Silica-glass cylinder with welded-on inner flange.*