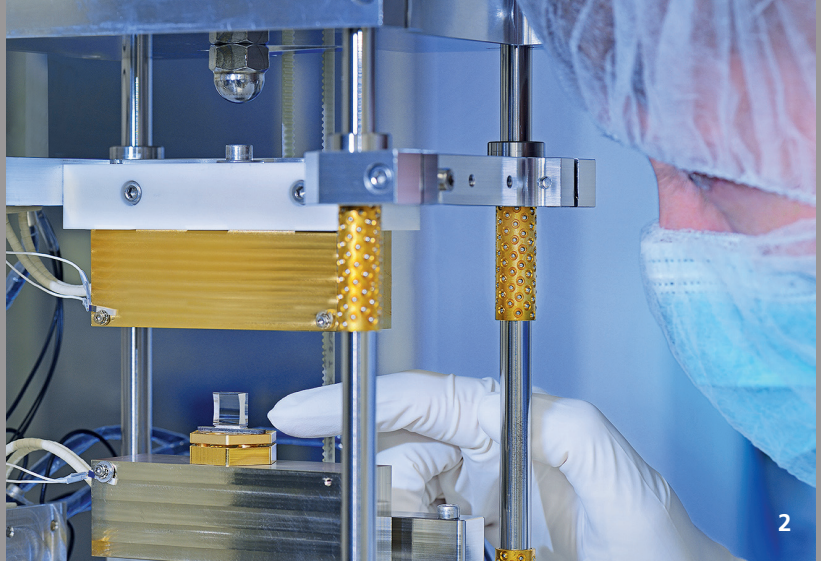

DEVELOPMENT OF AN ULTRASONIC VACUUM SOLDERING FURNACE

Task

When optomechanical components are assembled – those that must satisfy strict requirements on thermal conductivity, robustness, long-term stability and freedom from outgassing – soldering technologies have advantages over adhesive bonding processes. Soldering technology can be used to great advantage in high-power lasers and laser systems for aerospace applications. Here, soldering of the components is currently carried out with previously applied intermediary layers under vacuum or inert gas atmosphere.

With ultrasonic soldering, the industry applies solder to materials that are difficult to wet without needing intermediary layers. To reduce the effort with intermediary layers, Fraunhofer ILT is to develop a furnace for soldering under a vacuum or inert gas atmosphere and with simultaneous ultrasonic support.

Method

To this end, the institute is testing vacuum-compatible geometries and materials for the mechanical and electrical ultrasonic components. They should permanently withstand temperatures of up to 250 °C, but still exhibit a uniform frequency response over the entire temperature range from 25 °C to at least 250 °C. In addition, materials for the furnace's heating units are being investigated which exhibit high thermal conductivity, low heat capacity and efficient conduction of the ultrasound into the optomechanical components.

Results

With the developed furnace, optomechanical components of approx. 100 x 50 x 100 mm³ (LxWxH) can be soldered at a maximum temperature of 350 °C at an accuracy of ±1 °C. Pressures down to 5 x 10^{-6} mbar or various inert gas atmospheres can be generated. The ultrasonic power is a maximum of 30 W and has a frequency resonance of 34 kHz with a stability of ± 0.8 Hz over the temperature range of 25 °C to 350 °C. The furnace enables most soft solders to be used thanks to its many setting options for temperature, pressure, atmosphere and ultrasonic power.

Applications

Uncoated crystals and optical components for solid-state lasers can be soldered using the newly developed furnace. This is followed by a comparative study of conventional and ultrasound-assisted bonds.

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2 Ultrasonic soldering of an optic.