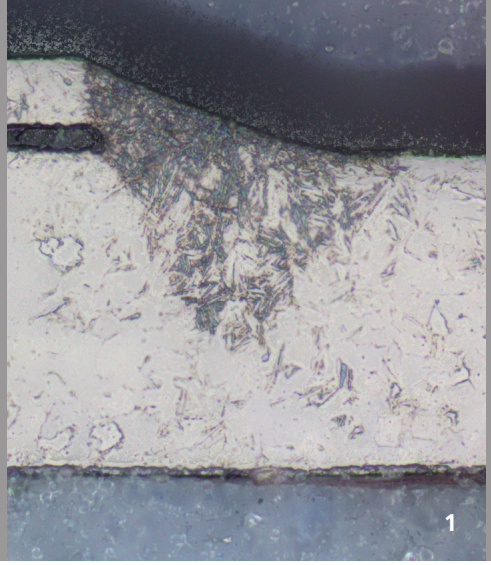

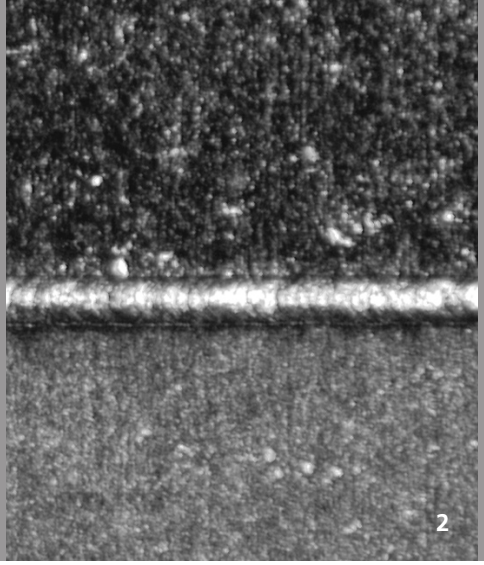

LASER WELDING OF TITANIUM MEMBRANES FOR THE PRODUCTION OF PRESSURE SENSORS

Task

New high-brilliance beam sources such as fiber lasers – having a fiber diameter < 15 µm and excellent focusability – allow fine welding seams in the range of a few microns in thickness and depth. Due to these parameters, fiber lasers are suitable, in particular, for joining thermally sensitive components on account of their minimal energy input. For example, a membrane of about 10 - 25 µm can be welded to titanium housing for intracorporeal pressure sensors.

The special challenge when welding thin membranes is a media-tight seam, which ensures it is burr-free, i.e. groove-free and has smooth upper and lower upper beads. Thanks to these types of seams, easily sterilizable tools can be produced, essential for medical applications.

Method

To manufacture the pressure sensor, laser ablation is used to generate a rectangular opening in a casing with a wall thickness of 100 µm. Subsequently, a titanium membrane of about 10 - 25 µm thickness is laser-welded onto that section, by which the pressure can be measured by a sensor. For this method, a 200 W fiber laser with high beam quality $M^2 < 1.1$ was used.

1 Micro-section.

2 Welding seam.

A welding seam was achieved both free of cracks and pores and with a smooth and gentle transition to the seam surface by means of a process-adapted welding device that enables a stable gap-free fixation of the membrane and a specific adaptation of the beam position on the edge of the component. Here, the main advantage of the new laser sources is evident, as they allow a highly accurate deposition of energy for the process and in the component ratios.

Result

Thanks to its small beam diameter, laser beam welding with fiber lasers enables the smallest melt volumes and, thus, much needed energy for welding. In this way, the previous limits of laser welding can be overcome, in particular when joining thin films and wires with low heat capacity.

Applications

Laser welding of titanium membranes can be used to produce devices for several medical applications, such those to measure blood pressure, intraocular pressure and bladder pressure. Further applications can be envisaged for contacting wires and lead frames.

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