Subject to alterations in specifications and other technical information. 06/2017.

LASER CUTTING OF POLYESTER-KNITTED FABRICS FOR APPLICATIONS IN TISSUE ENGINEERING

Task

A plastic knitted fabric made of polyester and seeded with human cells shall be produced for the manufacture of textile implants in the field of tissue engineering. For the required preliminary tests for implantation in mouse hearts, small round discs with a diameter of approx. 10 mm and a thickness of 3 mm are required as test specimens in order to create different cell cultures. Mechanical separation processes are usually associated with damage to knitted fabric, so laser cutting should be tested as an alternative separation process.

Method

Since polyester, like many other thermoplastics and thermosetting plastics, has high absorption values in the infrared spectral range, a CO_2 laser source with an emission wavelength of 10.6 µm is well suited for cutting it. The required laser power is determined in order to completely cut the approximately 3 mm thick knit at a given cutting speed and using a standard cutting head with plano-convex lens of 63 mm focal length as well as xyz linear axes for beam movement. The cutting edges are analyzed by means of an incident light microscope.

Results

By adapting the focus diameter and feed speed, Fraunhofer ILT has achieved high-quality cutting results. The flat edge zone of a Gaussian single mode CO_2 laser beam causes melting zones to form at the cutting edges. These areas harden after solidification and reduce the resilience of the customized molded part. This is, however, quite advantageous for the intended application of the component – as a heart implant – since the mechanical stability of the disk, which is thick compared to its diameter, increases.

Applications

Laser-cut polyester knitted fabrics for medical applications can be produced with great flexibility of shape even for small components with dimensions down to 5 mm. The resultant melt edge hardening increases the mechanical stability, prevents fraying of the knitted fabric and can be reduced by multiple crossings in case excessively high formation occurs. In the next step, the polyester knitted fabric shall be replaced by a biocompatible polyvinylidene difluoride (PVDF) fabric.

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1 Laser cut 10 mm round disc of 3 mm thick polyester knitted fabric. CO_2 laser cutting at 110 W, 2 m/s, 5 crossings, 230 µm beam diameter.