Stainless Steel Micropumps for Medical-, Laboratory- and Analysis Technology

In the field of laboratory and medical technology, the dosage of minimal quantities of fluids or gases is crucial. This requires efficient and reliable, yet economic microdosage systems. The piezoelectrically driven stainless steel microdiaphragm pumps, developed at Fraunhofer EMFT, generate flow rates of up to 200 ml/min (air) and up to 80 ml/min (water). They are suitable for various applications, such as:

- Negative pressure wound therapy (for the treatment of chronic wounds)
- Medical implants (e.g. drug delivery, artificial sphincter implant)
- Infusion pumps
- Air sampling for gas sensors
- Autonomous cell culture devices

Advantages

- Small size and scalable flow rates allow a wide range of applications
- Accurate dosing due to stroke volumes in microliter range
- Patent-registered piezo assembly process ensures a high back pressure capability with air as well as selfpriming and bubble tolerance with water
- Spring steel material provides excellent long-term properties
- All components in contact with the medium are biocompatible
- The pump is autoclavable, which allows hygienic re-use
Technical innovation

The design of the pump is individually adapted to special customer requirements, which guarantees the minimum size for the application in question. For creating the pump chamber, a patent-registered piezo assembly process is used, minimizing the internal dead volume. This improves the back pressure capability for operating with gases and allows self-priming and bubble tolerance when handling incompressible media like water.

Special membrane valves with a combined hard/soft seal guarantee increased tightness against back flow.

State of development

Demonstrators
Various models of robust stainless steel micropumps have already been implemented by means of laser beam welded multi-layer joints.

Automation
For the novel piezo assembly process, adhesive dosing equipment with pick-and-place automation was used. This makes partly automated fabrication possible.

Fabrication
The micropumps have already been fabricated in batch sizes more than 100.

Technical data

<table>
<thead>
<tr>
<th></th>
<th>µP303</th>
<th>µP304</th>
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</thead>
<tbody>
<tr>
<td>Size</td>
<td>Ø 29 mm x 2,6 mm</td>
<td>Ø 20 mm x 2,1 mm</td>
</tr>
<tr>
<td>Weight</td>
<td>13 g</td>
<td>5 g</td>
</tr>
<tr>
<td>Material</td>
<td>Stainless steel Silicon</td>
<td>Stainless steel Silicon</td>
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<tr>
<td>Max. flowrate (air)</td>
<td>200 ml/min</td>
<td>50 ml/min</td>
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<tr>
<td>Max. flowrate (fluid)</td>
<td>80 ml/min</td>
<td>16 ml/min</td>
</tr>
<tr>
<td>Back pressure capability (air)</td>
<td>20 kPa</td>
<td>25 kPa</td>
</tr>
<tr>
<td>Back pressure capability (fluid)</td>
<td>31 kPa</td>
<td>75 kPa</td>
</tr>
<tr>
<td>Energy consumption</td>
<td>&lt; 400 mW</td>
<td>&lt; 300 mW</td>
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</tbody>
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Flow rate characteristics of the stainless steel micropumps in respect of their size:

3 Stainless steel micropumps
µP303 (Ø 20 mm) and µP304 (Ø 29 mm)
4 Diaphragm valve