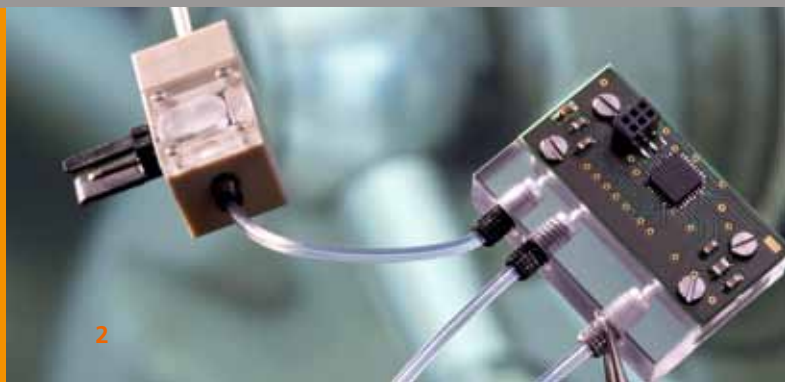
Fraunhofer
EMFT

FRAUNHOFER RESEARCH INSTITUTION FOR MICROSYSTEMS AND SOLID STATE TECHNOLOGIES EMFT


1


2

1 *Microdosing Module*
2 *Microdosage system for micro-lubrication of precision bearings in high-performance spindles*

MICRODOSAGE SYSTEM WITH PIEZO DRIVEN SILICON MICROPUMPS

Application areas

Handling and accurate dosing of smallest amounts of liquids or gases is essential for many application areas. Fraunhofer EMFT develops microdosage solutions customized for use in various applications, such as:

- Oil lubrication for engines and machinery
- Drug delivery systems
- Lab technology applications like pipetting
- Implantable systems for glaucoma therapy or drug delivery
- Scent dosage systems

Benefits

In many cases micropumps are vulerable to particles, have limited bubble tolerance, show "free flow" and have flow rates dependent on back pressure. The Fraunhofer EMFT microdosing unit based on a silicon micropump is a solution designed to overcome these drawbacks.

- Small size and low power consumption
- Excellent bubble tolerance
- High blocking pressures for liquids and gases
- Accurate dosing
- Integrated filter, invulnerable against particles and bubbles
- Protection against free flow
- High mechanical stability and lifetime

Technological innovation

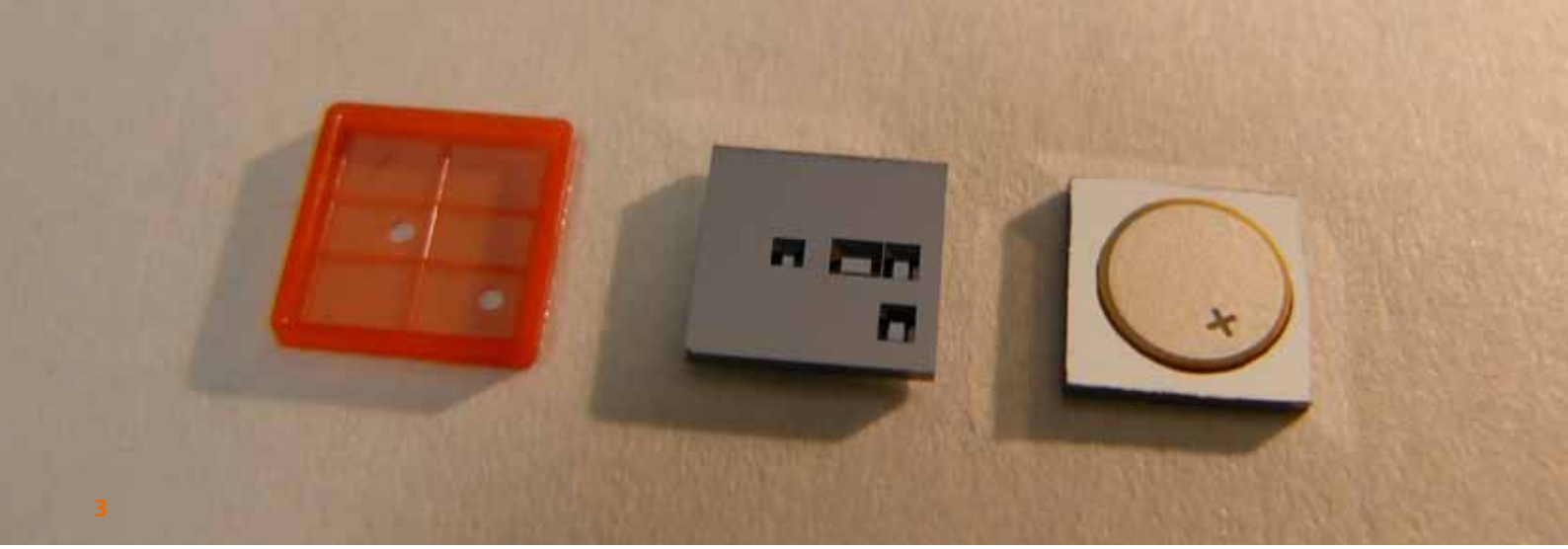
The heart of the ready-to-use complete microdosage system is the piezo electrically actuated micro diaphragm pump made of silicon. The pump chip features excellent bubble tolerance due to high compression ratio, very stiff back pressure dependency, and low stroke volume to enable accurate dosing of liquids or gases. The high pressure type has a blocking pressure of 6 bar (liquids)

Fraunhofer Research Institution for Microsystems and Solid State Technologies EMFT

Hansastrasse 27 d
80686 München
Phone: +49 89 54 75 90
Fax: +49 89 54 75 95 50
E-Mail: contact@emft.fraunhofer.de

Project Manager:
Dr. Martin Richter
martin.richter@emft.fraunhofer.de

www.emft.fraunhofer.de



3

and 1 bar (gases) respectively, which is a factor of three more than other piezo driven micropumps. Two types of micropumps (high flow and high pressure) with a chip size of 7 x 7 x 1 mm³ can be implemented as part of the system, according to the application. A filter unit is integrated to protect the micropump against particles. A safety valve avoids free flow if over pressure is applied at the inlet. In that case (e.g. if the patient pressurizes the drug reservoir), the silicone gasket of the safety valve will be closed self-blocking, allowing no free flow to occur, even at high inlet pressures. The pumprate can be adjusted by changing the actuation frequency using a driver electronics. Materials in contact with the fluid (liquid and/or gas) to be pumped are silicon, PEEK and silicone, allowing for excellent chemical stability and possible use in a wide range of applications. The micropump can handle a wide range of liquids (e.g. medical drugs, methanol, lubricants, analytes) and gases (e.g. for gas analysis, also corrosive gases, scent dosing). A stroke volume of 80 nl enables a very defined dosage, which is nearly independent on back pressure (1% loss of stoke at 6 kPa).The small size and low power consumption make applications in portable, battery driven devices feasible. A 40000 hours methanol test was successfully passed by a version of the siliconmicropump. Together with the high pressure abilities new applications can be realized in the future.

Status of development

First industry projects are set up to test the micro dosing systems for industrial or medical applications. Prototypes of dosing systems are available for evaluation within the framework of a feasibility study or an application project. Embodiments of the silicon micropump have been industrialised together with a MEMS fab.

Micropumps compatible to microdosage system with the following features

Technical data	High pressure type	Medium pressure type
Fraunhofer EMFT nomenclature	µP015v1	µP014sm200
Housing dimensions	**12,5 x 12,5 x 23 mm³**	**12,5 x 12,5 x 23 mm³**
Chip dimensions	**7 x 7 x 1 mm³**	**7 x 7 x 1 mm³**
Savety valve available	**Yes**	**Not yet**
Characteristics for Gas (Air):	*(5 µm pores filter)*	*5 µm pores filter)*
Stroke volume [nl]	**typical**	**typical**
Air	**≤ 40**	**≤ 50**
Water	**≤ 90**	**≤ 130**
(Gradient of a fit, based on flow measurements at 25, 50 and 100 Hz @ 0 hPa)		
Air:		
Max. Flow rate [µl/min]	**≤ 300**	**≤ 2000**
Max. back pressure [kPa]	**≤ 90**	**≤ 34**
Leakage rate [µl/min]	**≤ 60**	**≤ 60**
(0 Hz @ 100 hPa)		
Characteristics for liquid:	**Liquid (Water)** *(5 µm pores filter)*	**Liquid (Water)** *(5 µm pores filter)*
Water:		
Max. flow rate [µl/min]	**≤ 150**	**≤ 1000**
Max. back pressure [kPa]	**≤ 550**	**≤ 130**
Leakage rate [µl/min]	**≤ 1**	**≤ 1**
(0 Hz @ 100 hPa)		
Materials contacted by fluids	*Silicon, PEEK, Silicone*	*Silicon, PEEK, Silicone*

3 *High pressure micropump (size 7 x 7 x 1 mm³, bottom side with safety valve structures (left), and top side with piezo (right))*