



1 Pump family,
silicon and metal

2 Stainless steel micropump

MICRO DIAPHRAGM PUMPS PORTFOLIO OF FRAUNHOFER EMFT

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Applications

Micro diaphragm pumps made of silicon or stainless steel enable various new applications in diverse business fields, e.g.

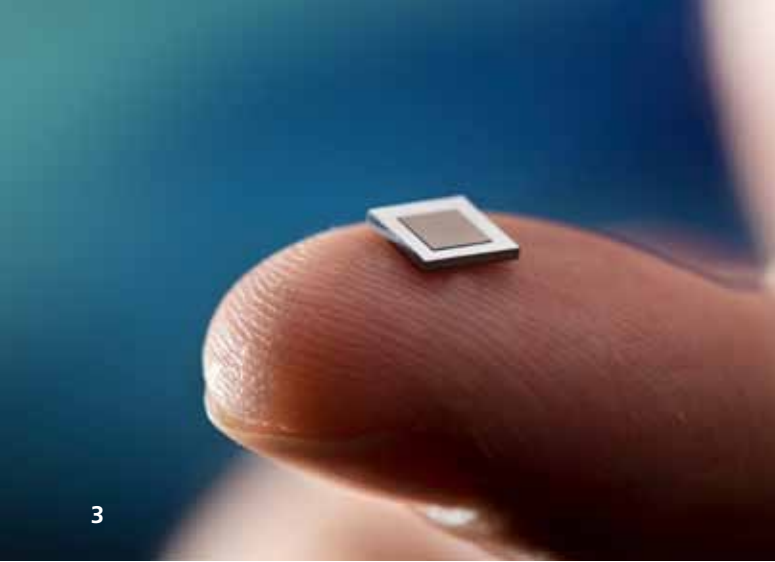
- **Consumer:** Use in smartphones or dosage systems for fragrances
- **Medical technology:** Systems for diabetes-, tumor-, hormone- or pain therapy, medical implants (silicon pumps), infusion, wound treatment (metal pumps)
- **Industry/production:** Dosage systems for small quantities of lubricants, fuel dosing systems, micro pneumatics, micro hydraulic systems and dosage systems in production processes
- **Safety /security applications:** Use in miniaturized systems for smoke detection or explosives detection
- **Laboratory technology:** Key component for ultralight air cushion pipette, filling of microtiter plates

- **Analysis systems:** Use in environmental monitoring systems, production monitoring systems or lab-on-chip applications

Technical innovation

Silicon micropumps:

- Extreme miniaturization and a specific pump design enables cost-efficient manufacturing of silicon micro pumps (in high volumes) for disposable products or in consumer applications.
- Miniaturized and flat design allows for integration in e.g. patches or watches.
- Significantly reduced dead volume leads to a high back pressure capability, even with gases, as well as an unparalleled suction capacity of more than 50 kPa.



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Metal micropumps:

- Larger design allows for significantly higher flow rates, enabling applications (like micro cooling, fuel cell technology, infusion technology or negative pressure wound therapy) to be addressed economically.

State of Development

Fraunhofer EMFT Micro diaphragm pump portfolio:

Pump type		μP015v1	μP024Av2	μP026v1	μP303	μP304
		silicon	silicon	silicon	steel	steel
Weight	g	0.07	0.06	0.03	13	5
Size	mm ³	7x7x0.8	7x7x0.7	5x5x0.6	OD=29, t=2.6	OD=20, t=2.1
Stroke volume	nl	80	140	50	25 000	6 000
Max. back pressure (air)	kPa	90	80	30	20	25
Max. suction pressure (air)	kPa	-50	-50	-20	-15	-20
Max. back pressure (liquids)	kPa	550	140	80	31	75
Max. flowrate (air)	μl/min	500	1 000	600	200 000	50 000
Max. flowrate (liquids)	μl/min	150	300	60	80 000	16 000

Outlook

The next step towards deployment of silicon micropumps in future applications requiring disposable products is transferring the technology into high-volume industrial production. This requires development of cost-efficient back-end steps, such as wafer-level piezo mounting and pump testing.

Funding

The development of pump type μP15v1 was funded within the Fraunhofer project TUDOS, pump type μP24Av2 within the joint project MIKROAUG (BMBF program „KMU innovativ“, project sponsor VDIVDE-IT), the stainless steel micropump type μP303 within the Fraunhofer project SKINHEAL (program “Märkte für Übermorgen”) and the micropump type μP304 within the EU-FP7-SME project SMOKESENSE.

3 Si-micropump, 5 mm x 5 mm, on finger

4 Completely processed micropump wafer