



Batch Fabrication of Polymer-Based Shape Memory Microvalves

Forschungszentrum Karlsruhe,
Institute for Microstructure Technology



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BACKGROUND and BASICS

Shape Memory Alloys (SMA)

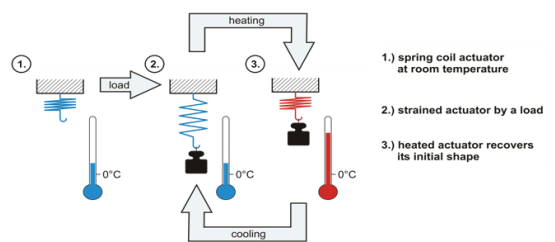
- very high energy density ($E/vol=107 \text{ J} \cdot \text{cm}^{-3}$) compared to other actuation principles
- favorable scaling behavior of SMA actuators

Shape Memory Microvalve

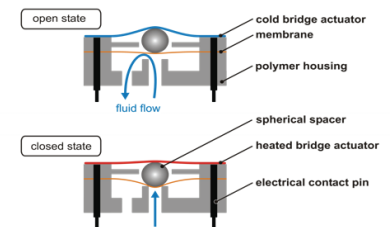
- open seat valve with polymer housing
- overall dimensions: 11x6x3mm³
- max. pressure: 3 bar
- max. flow: 400 standard ccm (gas); 15 ml/min (liquid)
- field of applications: biomedical, micro fuel cells

Technology problem: costly pick and place assembly

Functional principle of a SMA actuator



Functional principle of a SMA microvalve



CONCEPT and SOLUTION

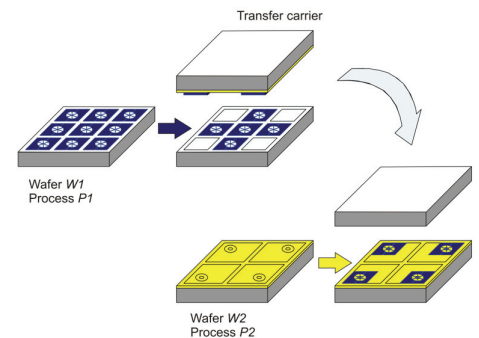
EU-Project Q2M:

- batch fabrication of SMA microvalves by transfer bonding technology to reduce production costs

Selective transfer bonding:

- separate processing of housing and actuator on the wafer scale
- transfer bonding of SMA microparts to microvalve housing after separate processing

Selective transfer bonding



STATUS and OUTLOOK

Pilot tests in laboratory:

- Batch fabricated normally open SMA microvalves

Current R&D projects:

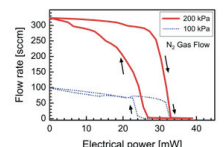
- Development of a bistable SMA microvalve
- Integration of an anemometric flow sensor into the SMA microvalve

We are looking for:

- End-users with readiness to invest (R&D)
- Producers to support market introduction

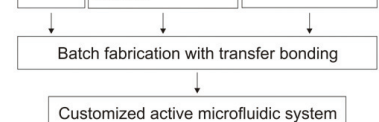


Batch fabricated SMA microvalves.



Typical flow characteristics of a batch fabricated SMA microvalve.

Actuator	Polymer	Design
- SMA - Piezo - Others	- PMMA - Ethanol- / Methanol-resistant polymers: * PSU * POM * PEEK - Others	- Normally open - Normally closed - Bistable - Variable flow rates



Possible combinations of materials, designs and actuation technologies.

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