

## **Technická zpráva – Funkční vzorek**

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Název: **Sensor for slug flow characterization**

Financováno: CENTEM, GAAV CR (IAA401280904),

specifický výzkum MŠMT č. 21/2012

Identifikační kód: G\_SlugFlowSensor

### **Description**

We have developed a sensor for the experimental characterization of the segmented flow in microfluidic devices. Sensor in a form of a plastic chip of specific electronic-compatible design combines two functions: Segmented flow generator in a form of T-junction producing the slugs flowing in the carrier fluid and array of golden microelectrodes on the bottom of the channel to sense the passing slugs. Functionality was proven on the two phase system kerosene-water.

### **Fabrication**

The microfluidic sensor consists of four parts:

- (i) PMMA plate with embedded golden microelectrodes,
- (ii) special connection blocs (Fujipoly<sup>®</sup>),
- (iii) PMMA counterplate with microfluidic and support structures
- (iv) commercially sold printed circuit (Roth elektronik) with soldered connection pads.

Microfluidic part is made by micromilling cutter. Channels have a square cross-section 1x1 mm. Golden electrodes are made by a specific combination of UV lithography and galvanic electroplating technology.

The method of electrode fabrication based on sacrificed substrate includes following steps:

- (i) UV lithography on phosphor-bronze substrate coated with a positive resist from Microresist technology<sup>®</sup> ma-P 1275,
- (ii) galvanic deposition of gold in the developed patterns with bath Auruna 311,
- (iii) photoresist stripping with acetone,
- (iv) embedding gold structures into UV curable PMMA resin Acrifix<sup>®</sup> 192 (Degussa<sup>®</sup>),
- (v) phosphor-bronze etching.

Depth of the deposited gold pattern is approximately 5  $\mu\text{m}$ .

In the next step, the PMMA surface of the electrode plate is treated with UV/O<sup>3</sup>, and then pressed and thermally bonded with the counter-plate (80 °C, 250 kg) at the assistance of isopropyl alcohol. The resulting plastic part is clenched together with the bottom part using special connection rubber blocks in between. These blocks contain a line of through-going golden wires with 100  $\mu\text{m}$  spacing. When

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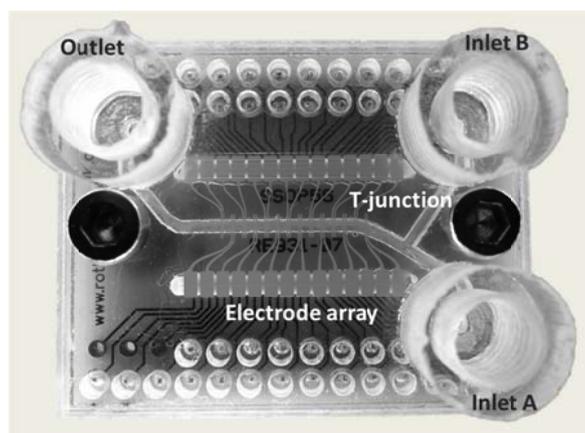
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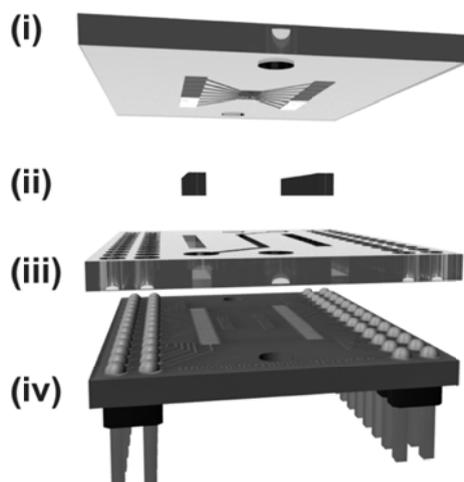
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pressed, the wires stab into the metal on both sides and form a solid connection. Current design contains an array of 28 single wired electrodes.



**Figure 1.** Example of a chip (37x30x2 mm). Inlet A – carrier phase (kerosene), Inlet B – dispersed phase (water solution).



**Figure 2.** Specific socket-like design of the chip (i) PMMA plate with golden electrodes array, (ii) connection blocs, (iii) microfluidic PMMA counter-plate, (iv) printed circuit with connection pads