Integrated membrane-free thermal flow sensor for silicon-on-glass microfluidics

Vitaly V. Ryzhkov et al., https://doi.org/10.48550/arXiv.2212.10916

This referee report reviews the paper "Integrated membrane-free thermal flow sensor for silicon-on-glass microfluidics" by Vitaly V. Ryzhkov et al. The paper describes the design, fabrication, and testing of a thermal flow sensor that can be integrated directly into a microfluidic channel or a lab-on-a-chip.

Good Things

The paper describes in great detail the fabrication processes used to produce the thermal flow sensor directly on a microfluidic channel. All the materials used are mentioned, along with their manufacturers. In addition, the functionality is clearly described in sufficient depth and illustrated with meaningful figures.

Major Comments

Overall, the methods used and described in the paper seem to be well put together and concise. However, when reading the report, there seem to be some things that are not obvious to the reader. These are summarised as follows:

- Nickel as the material used for the thermosensitive elements is mentioned in chapter *2.2. MTFS fabrication*. However, it is not clear why this choice was made. It would be helpful to include a small section at the end of the introduction on the criteria that led to this choice.
- In chapter *2.3. MTFS testing*, the test setup is described. Although it is mentioned that a LabVIEW program is used, a short paragraph on the data analysis and processing method would be helpful for a better understanding.
- *Figure 3* provides a good visualisation of the test setup and the measurement waveforms. However, the data in (b) appears to be raw, uninterpreted and shows time, which is irrelevant, at least on this scale. Since the calibration curve is already present in (c), you could show the measured flow rate as a function of the actual flow rate.
  Parts (d) and (e) describe the accuracy of the described MTFS, which is rather confusing as the rest of the chapter talks about the error rate. For a more coherent presentation, I would suggest changing the two graphs to error as a function of flow rate.
- In chapter *3.4. MTFS characterisation,* the calibration method is mentioned as "A single calibration procedure included 3-20 full-range stairstep-like passages and took 12-40 minutes", but it is not immediately clear what is happening in this timeframe. I think it would be helpful to give a brief insight into how much data is collected.

Furthermore, there is an unmentioned similar conference paper published in 2013 by Mielli and Carreño[1], which already includes a similar integrated nickel-based thermal flow sensor on glass. As they present similar ideas, I would recommend reading it and possibly making some comparisons.

Minor Comments

The paper is well structured and written, however, as I read through it I came across a few things which I have summarised as follows:

- There are several locations where a “the”, or “that” is missing or out of place.
- In the chapter *Author contributions* there are missing spaces after names abbreviated with dots (*I. A. Rod.* not *I.A.Rod.*). I would even suggest abbreviating only the first names and writing out the surnames.

Recommendations

In my opinion the paper is very well structured and concise. It is obvious that there is a lot of expertise involved, which has led to a novel and significant approach for microfluidics. What is particularly interesting is that it is very well suited for mass production as it is made in the same technology cycle as the microfluidic channel. I therefore recommend that this paper be published.

[1] http://dx.doi.org/10.1109/SBMicro.2013.6676148