STANDARDIZED AND MODULAR MICROFLUIDIC PLATFORM FOR FAST LAB ON CHIP SYSTEM DEVELOPMENT

Stefan Dekker*, Albert van den Berg and Mathieu Odijk

BIOS – Lab on a Chip Group, MESA+ Institute for Nanotechnology, Max Planck Center for Complex Fluid Dynamics, University of Twente, The Netherlands

ABSTRACT

This paper reports a modular microfluidic system with standardized parts, enabling rapid prototyping of lab on chip systems. Herewith contributing to the technology transfer from academy to industry. The use of standardized parts also makes it possible to design a microfluidic systems in a top down fashion. In contrast to the bottom up approach frequently used today, which often leads to reinventing the wheel. The novelty in our platform can be found by the use of an ISO workshop document, widely supported by many of the key microfluidic manufacturers and equipment suppliers.

KEYWORDS: Platform, Modular, Microfluidic Building Block, Fluidic Circuit Board, Standardization, Technology transfer.

INTRODUCTION

A modular microfluidic system with standardized parts will enable rapid prototyping of lab on chip systems. Herewith contributing to the technology transfer from academy to industry, still a major hurdle in maturing the microfluidics field[1]. Modular platforms have been shown before both in academia and commercially[2–5], but not using widely supported standardization. Our system is split in two types of components which are both standardized: microfluidic building blocks (MFBBs) and fluidic circuit boards (FCBs). The MFBBs contain certain microfluidic functionalities and the FCB interconnects these MFBB into a microfluidic system.

The use of standardized parts also makes it possible to design a microfluidic systems in a top down fashion. In contrast to the bottom up approach frequently used today, which often leads to reinventing the wheel. With the standardized MFBB, a microfluidic system can be designed in a top down functional fashion. The MFBBs themselves need a bottom up physical design. This design however, only needs to be made once and can be stored in a library of functional parts for future use. This split between the functional system design and physical building block design also provides the possibility to work on both tasks in parallel, providing faster times to market.

PHYSICAL STANDARD ELEMENTS

To make sure that MFBBs of different parties are interoperable, the physical dimensions of the MFBB are standardized as documented in an ISO workshop document[6]. As can be seen in fig.1: the outside dimensions, the position of the first interconnect and the pitch of the interconnects is standardized. Furthermore, the sealing configuration between the FCB and the MFBB is located in the FCB. Providing simpler fabrication, as the bottom of the MFBB can stay flat.

Within this grid the designer is free to choose suited inlet and outlet positions, there are however guidelines which indicate preferred positions.

In the future we envision big microfluidic part suppliers, analogous to their counterparts in the electronics industry (e.g Newark, Farnell, and others), where interoperable commercial of the shelf and standardized microfluidic components can be bought.

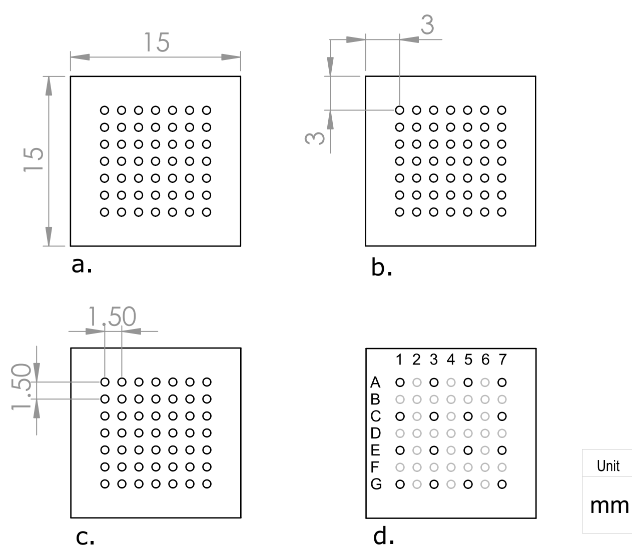

Figure 1: Standardized dimensions as proposed in ISO workshop document [6]: a. MFBB outline dimensions, b. Grid starting position, c. Grid pitch and d. Port annotation and preferred (bold) port positions.

RESULTS AND DISCUSSION

We have developed several MFBBs, as shown in fig.2. These parts include a fluidic reservoir (fig.2a) and a differential pressure sensor (fig.2b), which can also act as flow sensor. More MFBBs are developed by partners in the MFManufacturing project[7,8]. Moreover, a FCB was developed for testing purposes (fig.3). Knowing the hydraulic resistance of the channel, the flow through the channel can be calculated. Both in pressure mode and flow mode(fig.4) the sensor MFBB gives a highly linear output voltage with respect to the input quantity.

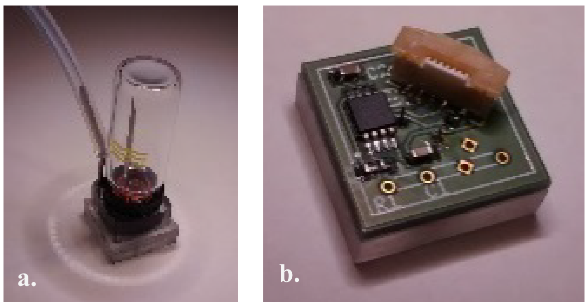

Figure 2: Standardized 15x15mm MFBBs: a) 1.5mL Fluid reservoir, b) Differential pressure sensor. Many other MFBBs are developed within the MF Manufacturing consortium [7].

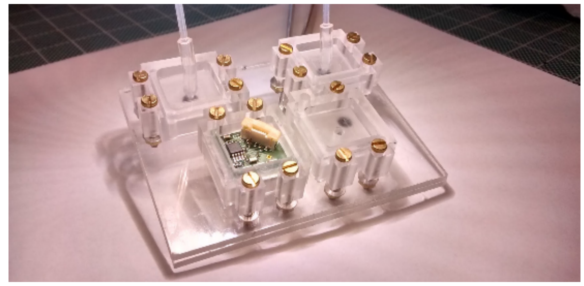

Figure 3: Fluidic circuit board (FCB) with mounted MFBBs, developed for testing purposes as shown in fig4.

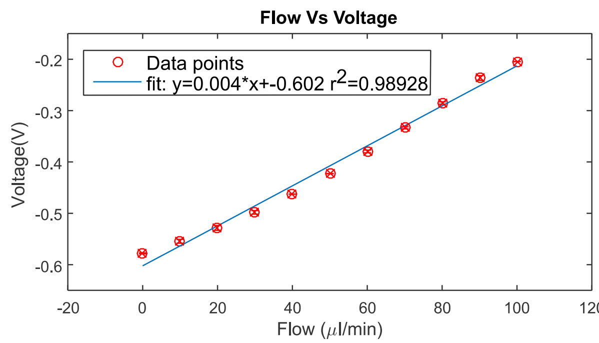

Figure 4: Flow characterization (R2=0.98928), Error bars indicate the hysteresis over the 1 repetition of the reference flow pattern.

CONCLUSION

In summary we present in this paper a new way of designing using a modular platform consisting of microfluidic building blocks and fluidic circuit boards. The novelty in our platform can be found by the use of an ISO workshop document, widely supported by many of the key microfluidic manufacturers and equipment suppliers. Within the consortium we hope to achieve wide adaptation by the introduction of a microfluidic marketplace[8].

ACKNOWLEDGEMENTS

This work was supported by ENIAC Joint Undertaking (JU), a public-private partnership focusing on nanoelectronics that brings together ENIAC Member/Associated States, the European Commission, and AENEAS (an association representing European R&D actors in this field). The standardization work wouldn't have been possible without the involvement of the partners in the MFManufacturing project.

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CONTACT

*S. Dekker; phone: +31534894578; s.dekker@utwente.com