Design and characterization of new membrane housings for Portable Hemodialysis Devices

Flávia S. C. Rodrigues[1,*], Mónica Faria[1]

[1] CeFEMA and Departamento de Engenharia Química, Instituto Superior Técnico, Universidade de Lisboa

* flavia.rodrigues@tecnico.ulisboa.pt

CeFEMA Center of Physics and Engineering of Advanced Materials

TÉCNICO LISBOA

Materials and technologies for health and environment

Aim: Design and fabrication of well-defined flow channel of a microfluidic membrane device using 3D printing technology.

INTRODUCTION

Patients with end stage renal disease (ESRD) are progressively increasing [1]. The most used therapy is hemodialysis (HD) [2].
Studies show that higher frequency HD not only increases the quality of life of ESRD patients but also lowers morbidity and mortality rates [3].
Novel microdevices designed to perform continuously will result in a smoother correction of uremic abnormalities and offer greater mobility for ESRD patients.

Early development of a portable artificial kidney (PAK) for the treatment of ESRD is envisioned based on a novel blood purification device that integrates membrane technology in a microfluidic system – the microfluidic membrane device (MFMD).

MATERIALS AND METHODS

Software: Onshape®
Printer: Ultimaker^{2+}
Material: Acrylonitrile butadiene styrene (ABS)

onshape

Ultimaker^2

The device was connected to an in-house built experimental system that simulates the extracorporeal blood circulation circuit found in HD machines and is capable of measuring very low pressure variations (< 1 mmHg) under dynamic conditions.
To characterize the membrane housing, experiments were performed by placing a non-permeable polyester transparency film in the place to be occupied by the HD membranes in the future.

RESULTS

Both channels were approximately 100 µm in height and that flow rates between 14 and 60 mL/min impose shear stresses between 6.3 and 27.8 Pa.

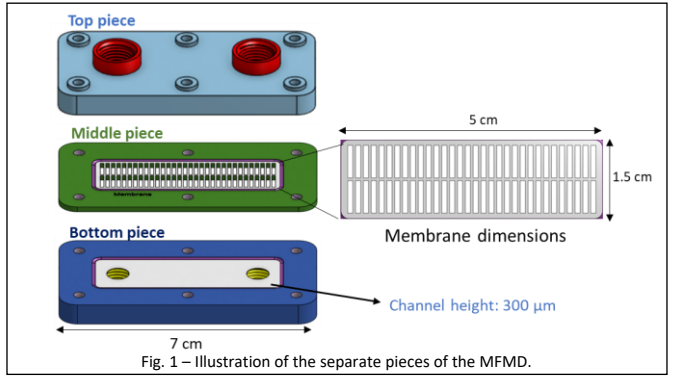

Fig. 1 – Illustration of the separate pieces of the MFMD.

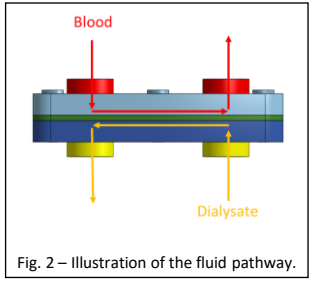

Fig. 2 – Illustration of the fluid pathway.

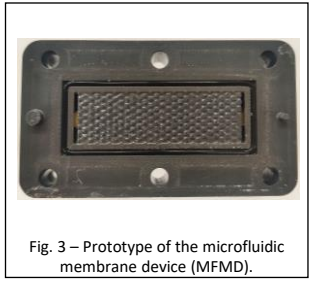

Fig. 3 – Prototype of the microfluidic membrane device (MFMD).

Experimental setup

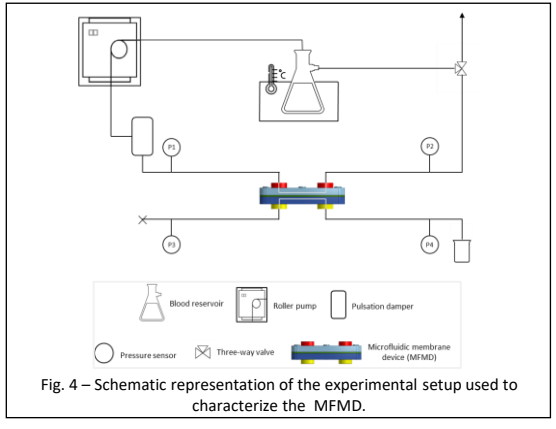

Fig. 4 – Schematic representation of the experimental setup used to characterize the MFMD.

REFERENCES

[1] **M. Faria** and **M. N. Pinho**, *Translational Ressearch*, 229, 115–134, (2021).
[2] **M. Faria**, C. Moreira, T. Eusébio, P. Brogueira and **M. N. Pinho**, *Cellulose*, 27, 3847-3869, (2020).
[3] J. P. Jonas, E. F. Leonard, G. Sandhu, G. Winkel, Levin N. W. Levin, S. Cortell, *Blood Purification*, 34, 325–331, (2013).

ACKNOWLEDGMENTS

Strategic project from CeFEMA - UID/CTM/04540/201
PhD research grant from FCT - UI/BD/150949/2021

FCT Fundação para a Ciência e a Tecnologia