i9MASKS

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Study of the Incorporation of Microchannels in PDMS

Introduction

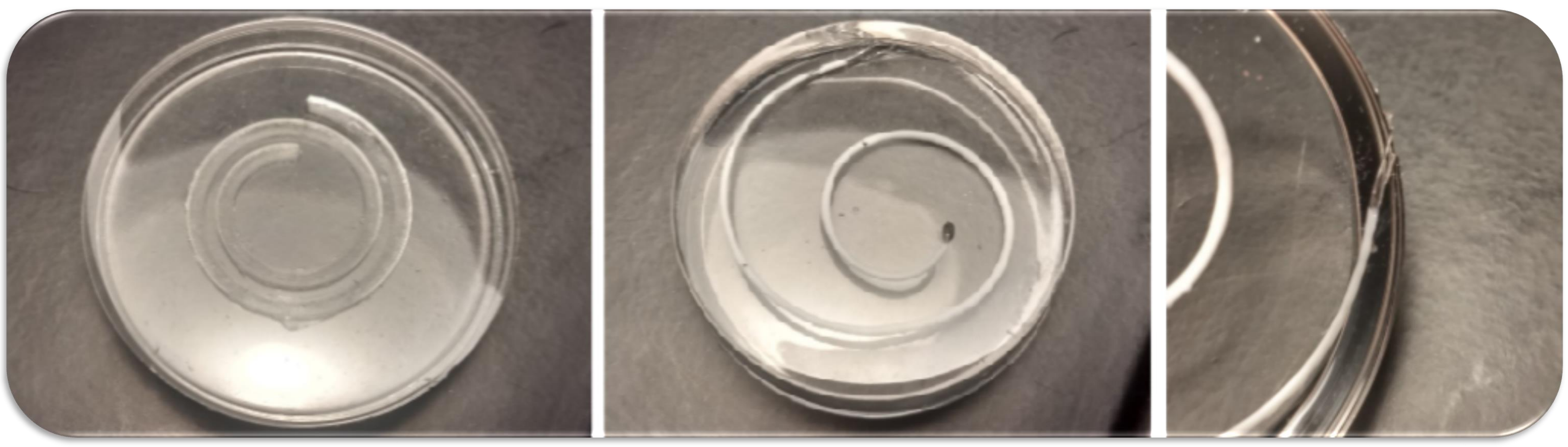
The SARS-CoV-2 coronavirus, that causes the COVID-19 disease, was first detected, in December 2019, in Wuhan, China, according to data from the World Health Organization (WHO). Due to the increasing number of cases and rapid spread in several countries, a State of Public Health Emergency of International Concern has been declared. Since then, the main form of control in the fight against the new virus has been the use of Personal Protection Equipment (PPE's) and social distance.
Transmission occurs mainly from person to person through respiratory droplets, when the individual coughs, sneezes or speaks close to other people. Contaminated surfaces or objects can also be sources of transmission [1].
The general population is oriented to use masks as a mechanical barrier to prevent droplet dispersion [2]. However, one of the problems encountered in the constant use of masks is related to the misting and condensation of water droplets expelled during breathing, requiring a study of alternatives that would solve such adversity. When addressing mask alternatives, another criterion is transparency, as the material should be colorless to enable face recognition. In this context, this work studied the incorporation of Polidimethilsiloxane (PDMS) microchannels into polymeric masks, with the purpose of creating air circulation regions, overcoming the masks current limitations.

Materials and methods

- Development of two-dimensional and three-dimensional microchannels in PDMS, manufactured using 3D printing;
- The print model of the springs was designed using CAD software Autodesk Fusion 360, with 25 mm external diameter and channel thicknesses of 0.5, 1.0 and 2.0 mm;
- Models were exported to the Ultimaker Cura 4.7 software where the print settings were defined (speed; support; techniques and extrusion configurations);
- Molds printed in PolySmooth polymeric material, followed by a polishing process;
- Polished springs inserted in a PDMS matrix (10:1 ratio, 6h curing at 40ºC) and later, the matrices were immersed in isopropyl alcohol at 60ºC until the complete formation of the channel by the degradation of the PolySmooth polymer.

Results & Conclusions

The removal of the canal was complete for planar structures, whereas in three-dimensional structures, complete removal did not occur, as Polysmooth only interacted with the solvent at the mold ends, increasing the polymer decomposition time. No interactions were detected between the mold and the matrix polymers.
The results of this research were quite satisfactory, since an alternative was found to solve the problem of breathability and condensation in PDMS masks, using 3D printed channels. These microstructures can be incorporated during manufacture and are easily removable by immersion in isopropyl alcohol, which does not cause damage when interacting with the PDMS.



References

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