



UNIVERSITÀ DEGLI STUDI DI TORINO

AperTO - Archivio Istituzionale Open Access dell'Università di Torino

## Permeability tuning of 3D printed azo-based membranes

This is the author's manuscript
Original Citation:
Availability:
This version is available http://hdl.handle.net/2318/1806010 since 2021-09-28T11:18:05Z
Terms of use:
Open Access
Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)

## Permeability tuning of 3D printed azo-based membranes

Matteo Gastaldi<sup>a</sup>, Ignazio Roppolo<sup>b</sup>, Marco Zanetti<sup>a</sup>, Silvia Bordiga<sup>a</sup>, Andrea Fin<sup>c</sup>, Matteo Bonomo<sup>a</sup>, Matteo Signorile<sup>a</sup>, Guido Viscardia and Claudia Baroloa POLITECNICO DI TORINO UNIVERSITÀ DEGLI STUDI DI TORINO

<sup>a</sup>Department of Chemistry and NIS Interdepartmental Centre and INSTM Reference Centre, University of Turin, Turin 10125, Italy <sup>b</sup>Department of Applied Science and Technology DISAT, Politecnico di Torino, Turin 10129, Italy Department of Drug Science and Technology, University of Turin, Turin 10125, Italy



matteo.gastaldi@unito.it



## Introduction

Three-Dimensional Printing (3DP) has assumed a central role in recent years both in academic and industrial fields. Functional dyes have been recently used to enlarge the palette of available polymers.<sup>[1]</sup> Materials able to change chemical, mechanical or optical properties, under an external stimulus, such as light, temperature or mechanical stresses, are examples of these appealing research.[2]

Here we have synthetized and characterized azodyefunctionalized polymethacrylates for Digital Light Processing (DLP). The introduction of small amount of dyemonomers into the liquid formulation produced noticeable changes in gas permeability properties of the 3DP polymeric membranes.[3]

We tested CO<sub>2</sub>, O<sub>2</sub> and H<sub>2</sub>O permeability, noting an increase in the transmission rate (T,) and a reduction in water permeability. Moreover, an instant rise in the CO2 Tr can be obtained under green laser irradiation (532 nm), while no remarkable effects are obtained for other gases.



A) Schematic representation of the monomer preparation: a) NaNO<sub>2</sub>, AcOH, HCI, H<sub>2</sub>O, 0° to 5° C to rt, 4 hours. b) TEA, THF, rt, 18 hours.





Bisphenol A ethoxylate diacrylate

Phenylbis(2,4,6-trimethylbenzoyl)phosphine oxide

B) Monomer used in the formulation for the Digital Light Processing (DLP). C) Photoinitiator used to start the radical polymerization.



## Conclusion

The different transmission (Tr) rates registered for the introduced polymer are, most likely, related to the presence of the azo groups. They can increase the transmission rate of an almost totally gas impermeable polymeric membrane.

According to the steric hindrance of the ortho functional groups, different Tr values were obtained. The only functionalized samples that seem to not follow this trend are the ones with H and Cl as ortho groups. These samples are actually under investigation.

Under green laser irradiation (532 nm) a rapid and reversible increase in permeability of CO2 was observed. The same behavior can't be registered for other gases. A possible application of these membranes is under investigation, to realize 3DP devices with different tunable gas selectivity.

[1] Layani, M.; Wang, X.; Magdassi, S. Adv. Mater. 2018, 30, 1706344.

[2] Gastaldi, M.; Cardano, F.; Zanetti, M.; Viscardi, G.; Barolo, C.; Bordiga, S.; Magdassi, S.; Fin, A.; Roppolo, I. ACS Mater. Lett. 2021. 3. 1-17. [3] Gillono, M.; Roppolo, I.; Frascella, F.; Scaltrito, L.; Pirri, C. F.; Chiappone, A., Appl. Mater. Today 2020, 18, 100470.

POR FESR/FSE 2014/2020

research leading to these results has received funding from the European Union and the Regione Piemonte, Piattaforma Tecnologica "Fabbrica Intelligente" - SMART 3D Project.