Mixed Matrix Membranes based on PPO and graphene for gas separation

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INTRODUCTION

We fabricated new mixed matrix membranes (MMMs) based on poly(2,6-dimethyl-1,4-phenylene oxide), PPO, a dense permeable and hydrogen selective glassy polymer. The MMMs were obtained by adding graphene at different percentages, up to 15%$_{wt}$, and the gas transport properties were measured via a pure gas permeometer at 35°C and 65°C.

SAMPLES PREPARATION

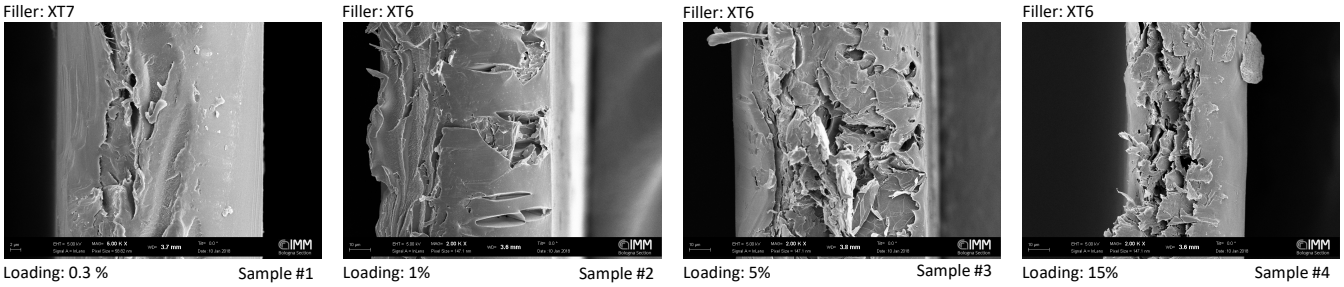
Two different graphene nanoparticles, XT6 and XT7, provided by Graphene XT were used for this study. Solid PPO (Sigma Aldrich) was dissolved in chloroform (purity > 99,5%, Sigma Aldrich) at 5%$_{wt}$ and, after the graphene addition, the suspension was sonicated, 15 min. and 1 hr. for XT6 and XT7 respectively, stirred for 1 day and casted in a glassy Petri dish at 50 °C. A post-treatment at 200°C under vacuum for 1 day stabilizes the polymer properties.

FILLER CHARACTERISTICS

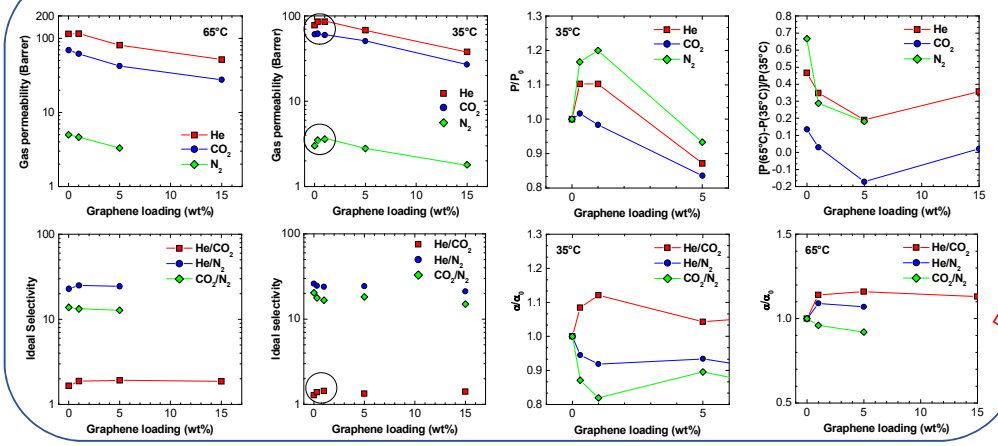
In the table below we show the nanofillers geometrical characteristics and the %$_{wt}$ in respect to PPO used in this study.

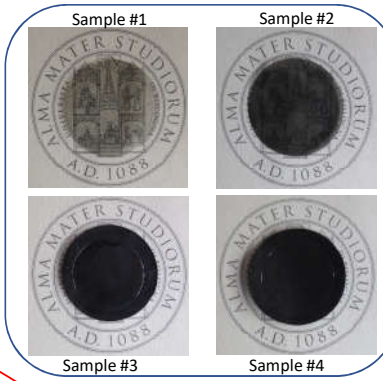
Filler Type	Lateral Dimension µm	Thickness nm	%$_{wt}$ in PPO
XT6	5	6.0-8.0	1.0 - 5.0 - 15.0
XT7	20	2	0.3

SEM PICTURES



PERMEABILITY & SELECTIVITY





P_0 = PPO permeability
α_0 = PPO selectivity

CONCLUSIONS

- Graphene in small quantities enhances the PPO free volume, permeability & selectivity.
- Higher loadings of graphene increase the tortuosity and lower the PPO permeability.
- Graphene addition reduces the polymer chain mobility and the temperature-dependence of permeability &selectivity of the polymer, ultimately enhancing its stability.

References

[1] R.Rea et al., *Polymers* **2018**, *10,19*

[2] L.Olivieri et al., *Ind. Eng. Chem. Res.* **2015**, *54*

[3] Y, Huang et al., J. *Polym. Sci.: Part B: Polym. Phys.* **2007**, *45*

[4]B.M. Yoo et al., *Curr. Op. Chem. Eng.* **2017**, *16*