Role of the surface and structure in the bactericide properties of Cellulose acetate/Ag nanoparticles asymmetric membranes

M.G. Sánchez-Loredo[1], A.S. Figueiredo[2], A.M. Ferraria[2], A.M. Botelho do Rego[2], S. Monteiro[2], R. Santos[2], M.N. de Pinho[2]

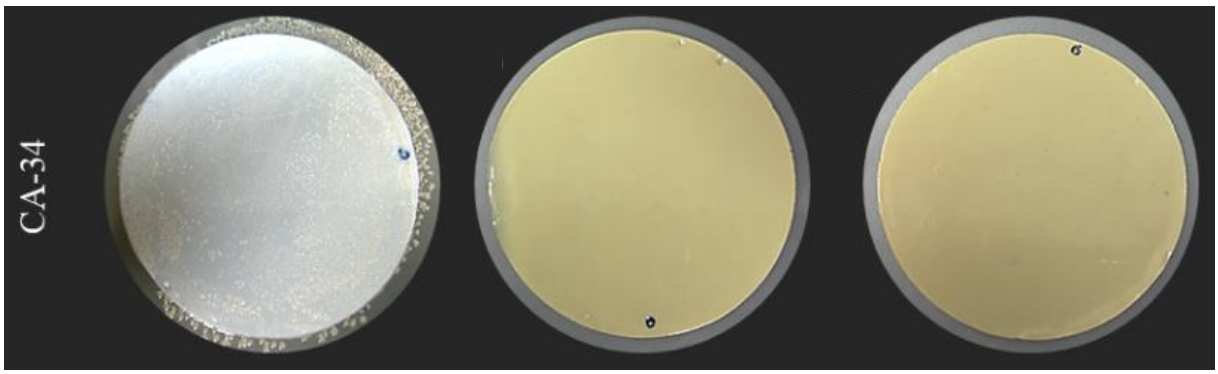
[1] *Instituto de Metalurgia, Universidad Autónoma de San Luis Potosí, San Luis Potosí 78210, Mexico*
[2] *Instituto Superior Técnico, Universidade de Lisboa, 1049-001 Lisbon, Portugal*

msanchez@uaslp.mx

The antibacterial properties of cellulose acetate/AgNp ultrafiltration membranes, prepared by the phase inversion method [1-3], were correlated with their asymmetric porous structures, with emphasis in the features of both the active and porous layers surfaces. The variation of the ratio acetone/formamide in the casting solution, as well as the polyvinylpyrrolidone-covered AgNP content, resulted in a wide range of porous structures. Studies assessing the antibacterial activity against *E. coli* (cell death and growth inhibition of bacteria in water) were performed on both membrane surfaces and in *E. coli* suspensions, and the results were correlated with the surface chemical composition assessed by X-ray photoelectron spectroscopy.

As expected, the silver-free membranes presented a generalized growth of *E. coli*, and the membranes containing AgNP displayed inhibition patterns, where growth inhibition depends on the accessibility of *E. coli* to the silver. The more permeable membranes (CA30 and CA34 series) have higher silver signal detected by XPS. On the other hand, the inhibition action was independent of the membrane porous structure when the membrane is deeply immersed in an *E. coli* inoculated suspension, presenting almost complete growth inhibition. The results provided strong evidence of bacterial growth inhibition in water contacting CA/Ag membranes, independently of structure, silver content, aggregation degree, and distribution of the particles in both dense and porous layers.

Acknowledgement: Funding by Fundação para a Ciência e Tecnologia. AMF thanks IST for contract IST-ID/131/2018. MNdP and MGSL thank the Cyted Network Aquamemtec for financial support.



(a) (b) (c)

Fig. 1. E. coli growth inhibition on the membrane for the suspension test. (a) CA34; (b) CA34Ag0.1, CA34 membrane with 0.1%wt Ag, and (c) CA34Ag0.4, CA34 membrane with 0.4%wt Ag.

References:

[1] B Kunst, SJ Sourirajan, Appl. Polym. Sci. **18**, 3423 (1974)
[2] AS Figueiredo *et al*., J. Appl. Polym. Sci. **132**, 41796 (2015)
[3] AS Figueiredo et al., Membranes **13**, 4 (2023)