NAPLES, ITALY 6-10 JULY
NANOSMAT Naples
16th International Conference on Surfaces, Coatings, and Nanostructured Materials

16th International Conference on Surfaces, Coatings and Nanostructured Materials
www.nanosmat.org/special.html

ABSTRACT:

Electrical Responsive Membranes for Moisture Detection and Regulation: a sustainable solution to the preventive control of indoor environmental conditions

A. Gugliuzza

Research Institute on Membrane Technology-National Research Council (ITM-CNR), Via Pietro Bucci 17C, Rende CS, 87036, Italy

One of the major efforts for galleries, libraries, archives, and museums is to preserve and store for a long time the cultural artefacts in their collections. The heritage preservation is mostly dependent on the environmental control in facilities. Fluctuation of humidity and temperature speed up transformation, ageing, and deterioration of collections, painting, statues and other objects. Humid conditions accelerate deposition and harmful actions of particles, pollutants and microorganisms on the surfaces with subsequent rapid materials decay. Sophisticated and sustainable tools are hence needed to monitor and keep constant targeted microenvironments. The membrane technology creates innovative, pragmatic and sustainable solutions to challenging preventive conservation of ambience [1]. Membranes are regarded as microarrays where singular and complementary functions can be adjusted, taking the advantage of combining surface detection and bulk transport in a single device [2]. A sustainable strategy to fabricate electrically activated membranes, which work as an integrated sensor-regulator of moisture, is herein discussed. A bio-inspired nano-assembly approach is used to generate highly ordered microporous platforms working as a support for electrical charge pathways [3]. A pH-assisted layer-by-layer grows functional carbon nanotubes hybrid networks, while pendant chemical moieties direct nanotubes stratification and aggregation, yielding a different number of interconnections and quality-electrical charge pathways [4]. An electrical current passage of the order of mA is measured at very low voltages through better-quality nanotubes networks; a variation of the electrical resistance up to 28% is detected as a response to severe changes in the surrounding environment due to assisted proton diffusion as a resulting doping effect by water [5-6]. Further, the nanotubes moieties are identified as moisture transporters due to their different ability to interact with water molecules through donor/acceptor interactions; so controlled rate of humidity can be yielded

under different environmental conditions. These multifunction membranes are regarded as desirable integrable solutions to monitor and control indoor environmental conditions. They are expected to pave the way toward the design of smart-concept ventilation and conditioning systems.

References

[1] Smart Membranes and Sensors: Synthesis, Characterization, and Applications, p. 448, A. Gugliuzza, Ed. (Wiley-Scrivener Publishing, 2014).
[2] Z. Cheng, S. Li, E. Tocci, G. Saielli, A. Gugliuzza, Y. Wang, Membranes 13, 749 (2023).
[3] V. Speranza, F. Trotta, E. Drioli, and A. Gugliuzza, ACS Appl. Mater. Interf. 2, 459 (2010).
[4] A. Gugliuzza, Adv. Manuf., 1, 29 (2024).
[5] V. Pingitore, and A. Gugliuzza, J. Phys. Chem. C 117, 26562 (2013).
[6] A. Gugliuzza, V. Pingitore, D. Miriello, and E. Drioli, Phys. Chem. Chem. Phys. 17, 12919 (2015).
[7] V. Pingitore, D. Miriello, E. Drioli, and A. Gugliuzza, Soft Matter 11, 4461 (2015).