RAMAN AND AFM STUDY OF NAFION/AGNWS/PDMS MEMBRANES

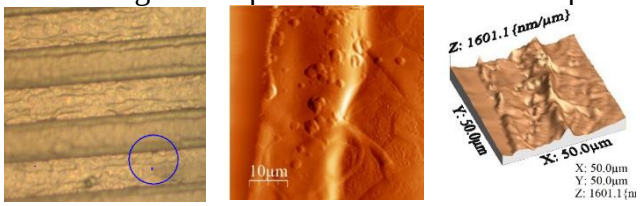
Florina Stefania Rus, Radu Banica

National Institute for Research and Development in Electrochemistry and Condensed Matter, 300569 Timisoara, Aurel Paunescu Podeanu Street No. 144, Romania
e-mail: rusflorinastefania@gmail.com

Abstract

The synthesis of composite functional materials with unique optical, mechanical, or electrical properties has garnered increasing attention in recent times. Researchers are especially interested in developing self-cleaning surface materials because of the positive environmental impact on both indoor and outdoor air quality. Integration of inorganic nanoparticles into a polymer matrix results in functional hybrid nanocomposite materials with specialized chemical and physical characteristics. The parts of the composite, the dimension and shape of the nanomaterial particles, and the type of bonding that occurs between the polymer and the nanomaterial phases all influence the hybrid system's characteristics.

The aim of the present study was to obtain a new hybrid composite with self-cleaning property consisting of Nafion/AgNws/PDMS membranes as active compound. The PDMS is a material with a number of advantageous stamping and molding qualities. It offers a surface with good gas permeability, strong thermal stability, low interfacial free energy, chemical inertness, a good host material for this study because of its optical trans-parency in the ultraviolet-visible-near-infrared region [1]. To create interdigitated electrodes, polydimethylsiloxane membranes were profiled and heated above the boiling point of the solvent before being sprayed with an ethanolic suspension of silver nanowires and a 0.1% Nafion 117 solution. Raman, UV-VIS spectroscopy and AFM microscopy were used to characterize the samples in order to evaluate the PDMS/AgNws/Nafion hybrid structure. AFM tests on the depressive disorders of the sample profiles were performed to estimate the surface of the sample observed in the 3D pictures at a greater resolution. The AFM pictures in Figure 1 show a rather smooth and compact surface of the nafion, with no large-sized pores in the material's depth.



(a) (b) (c)

Figure 1. (a-b) - 2D image and c) 3D image of the PDMS/AgNws/Nafion hybrid structure at 10x magnification

As a measure of the surface texture, the values of the surface roughness at both scales were calculated for analyzed surface. At the micrometric level, the principal roughness is determined by the edges of the droplets sprayed on the heated surface, which have heights in the tens of nanometers.

Acknowledgements

This work was supported by a grant of the Ministry of Research, Innovation and Digitization, CCCDI-UEFISCDI, project number PN-III-P2-2.1-PED-2021-2541, within PNCDI II.

References

[1] Gale, B.K., Eddings, M.A., Sundberg, S.O., Hatch, A.C., Kim, J., & Ho, T.A. (2008). Low-Cost MEMS Technologies.