PACS: 68.35.bj, 68.55.J-, 68.35.Np

Methods for changing the free surface energy of thin films based on indium and tin oxides obtained by laser-oriented deposition

A. S. Toikka[1,2] *and N. V. Kamanina*[1,2,3,4]

[1] St. Petersburg Electrotechnical University
5 ul. Professora Popova, St. Petersburg, 197022, Russia

[2] Petersburg Nuclear Physics Institute
1 Orlova Roshcha, Gatchina, 188300, Russia

[3] Joint Stock Company Scientific and Production Corporation S. I. Vavilov State Optical Institute
36/1 Babushkina st., St. Petersburg, 192171, Russia

[4] Vavilov State Optical Institute
5 Kadetskaya liniya V. O., St. Petersburg, 199053, Russia

Received 26.02.2024; revised 19.03.2024; accepted 28.03.2024

This work is devoted to the study of the effect of surface treatment of thin films based on indium tin oxides (ITO) in oxygen plasma on surface free energy (SFE). Modifications based on ITO with carbon nanotubes deposited by laser-oriented deposition were compared with ITO surfaces obtained by magnetron sputtering. The study was carried out by measuring contact wetting angles followed by calculating the SPE using the Owens-Wendt method. It has been shown that with the combined use of a CNT-based buffer and plasma treatment of ITO surfaces, a restructuring of the polar and dispersive components of the SFE is possible in the ranges of 0.1–67.5 mJ/m^2 and 9.7–22.7 mJ/m^2. These approaches make it possible to expand the functionality of modifications based on ITO with CNTs in optical electronics.

Keywords: surface free energy, indium tin oxides, carbon nanotubes, plasma treatment.

REFERENCES

1. Ozkartal A., Vacuum **168** (108799), 1 (2019).
2. Adurodija F. O., Izumi H., Ishihara T., Yoshioka H., Motoyama M. and Murai K., Journal of Vacuum Science & Technology A. **18**, 814 (2000).
3. Dong L., Zhu G. S., Xu H. R., Kiang X. P., Zhang X. Y., Zhao Y. Y., Yan D. L., Yuan L. and Yu A. B., Journal of Materials Science: Materials in Electronics **30**, 8047 (2019).
4. Kamanina N. V., Vasil'ev P. Ya. and Studeonov V. I. Optical coating based on oriented in electric field carbon nanotubes for optical instrumentation, micro- and nanoelectronics when leveling the interface medium: solid substrate - coating. Patent for invention № 2405177 (RF). 2010.
5. Chen Y., Du Chaoling D., Sun L., Fu T., Zhang R., Rong W., Cao W., Li X., Shen H. and Shi D., Scientific reports **11** (14550), 1 (2021).
6. Kim S., Oh H., Jeong I., Kang G. and Park M., ACS Appl. Mater. **3** (7), 3207 (2021).
7. Kamanina N. V., Toikka A. S., Barnash Ya. V., Redka D. N., Lihkomanova S. V., Zybtsova Yu. A., Kyzhakov P. V., Jovanovic Z. M. and Jovanovic S., Liquid Crystals and their application **22** (4), 83 (2022).
8. Yokoyama H., Mol. Cryst. Liq. Cryst. **165** (1), 265 (1988).
9. Barua P. and Hwang I., Materials **16** (2111), 1 (2023).
10. Lu L. and Gunasekaran S., Talanta **194**, 709 (2019).

11. Elmas S., Korkmaz S. and Pat S., Journal of Materials Science: Materials in Electronics **30**, 8876 (2019).
12. Besbes S., Ben Ouada H., Davenas J., Ponsonnet L., Jaffrezic N. and Alcouffe P., Materials Science and Engineering: C **26** (2-3), 505 (2006).
13. Ozbay S., Erdogan N., Erden F., Ekmekcioglu M., Ozdemir M., Aygun G. and Ozyuzer L., Applied Surface Science **529** (147111), 1 (2020).
14. Ozbay S., Erdogan N., Erden F., Ekmekcioglu M., Rakop B., Ozdemir M. and Aygun G., Applied Surface Science **567** (150901), 1 (2021).
15. Toikka A., Ilin M. and Kamanina N., Coatings **14** (2), 178 (2024).
16. Polat O., Bhethanabotla V. R., Ayyala R. S. and Sahiner N., Plasma Chemistry and Plasma Processing **43**, 737 (2023).
17. Chytrosz-Wrobel P., Golda-Cepa M., Stodolak-Zych E., Rysz J. and Kotarba A., Applied Surface Science Advances **18** (100497), 1 (2023).
18. Gao X., Lin B., Lin J., Chen H. and Wu Z., Displays **76** (102373), 1 (2023).
19. Van Oss C. J., Chaudhury M. K. and Good R. J., Chem. Rev. **88** (6), 927 (1988).
20. Toikka A. S., Fedorova L. O. and Kamanina N. V., Opticheskii zhurnal **91** (1), 91 (2024) [in Russian].