PACS: 77.55.hd

Planar capacitor structures with an amorphous AlN based dielectric layer

A. K. Akhmedov[1], *E. K. Murliev*[1], *M. A. Gitikchiev*[2], *A. T. Temirov*[2] *and A. Sh. Asvarov*[3]

[1] Institute of Physics, Dagestan Federal Research Center of Russian Academy of Sciences

94 Yaragskogo st., Makhachkala, 367015, Russia

[2] Dagestan State Technical University

70 Imam Shamil Ave., Makhachkala, 367026, Russia

[3] National Research Centre "Kurchatov Institute"

59 Leninsky Ave., Moscow, 119333, Russia

E-mail: abil-as@list.ru

Received 1.02.2024; accepted 22.02.2024

Amorphous dielectric AlN films with a smooth surface morphology and a dense and uniform structure, characterized by an optical band gap of about 6.1 eV, a relative dielectric constant of 8.5 and high optical transparency in a wide spectral range from the near-UV to mid-IR, were obtained by the reactive radio-frequency (RF) magnetron sputtering of an aluminum target in an atmosphere of an Ar–N_2 gas mixture (ratio 15:1) at a relatively high pressure in the chamber at a level of 2.7 Pa, an RF discharge power of 100 W and room temperature of the substrate. The possibility of low-temperature production of integrated capacitor structures based on the AlN films, including transparent planar capacitive structures for various optoelectronic applications, is demonstrated.

Keywords: thin film, magnetro sputtering, AlN, transparent electrode, capacitor.

REFERENCES

1. Li N., Ho Ch. P., Zhu Sh., Fu Y. H., Zhu Y. and Lee L. Y. T., Nanophotonics **10** (9), 2347 (2021). doi: 10.1515/nanoph-2021-0130
2. Xiong C., Pernice W. H. P., Sun X., Schuck C., Fong K. Y. and Tang H. X., New J. Phys. **14** (9), 095014 (2012). doi: 10.1088/1367-2630/14/9/095014
3. Pernice W. H. P., Xiong C. and Tang H. X., J. Nanophotonics **7** (1), 073095 (2013). doi: 10.1117/1.JNP.7.073095
4. Majkić A., Puc U., Franke A., Kirste R., Collazo R., Sitar Z. and Zgonik M., Opt. Mater. Express **5** (10), 2106 (2015). doi: 10.1364/OME.5.002106
5. Liu X., Bruch A. W., Gong Z., Lu J., Surya J. B., Zhang L., Wang J., Yan J. and Tang H. X., Optica **5** (10), 1279 (2018). doi: 10.1364/OPTICA.5.001279
6. Hu Z., Long L., Wan R., Zhang Ch., Zhang L., Yan J., Duan H. and Wang L., Opt. Lett. **45** (13), 3466 (2020). doi: 10.1364/OL.395909
7. Sinha N., Wabiszewski G. E., Mahameed R., Felmetsger V. V., Tanner Sh. M., Carpick R. W. and Piazza G., Appl. Phys. Lett. **95** (5), 053106 (2009). doi: 10.1063/1.3194148
8. Karabalin R. B., Matheny M. H., Feng X. L., Defaÿ E., Le Rhun G., Marcoux C., Hentz S., Andreucci P. and Roukes M. L., Appl. Phys. Lett. **95** (10), 103111 (2009). doi: 10.1063/1.3216586
9. Fei C., Liu X., Zhu B., Li D., Yang X., Yang Y. and Zhou Q., Nanomater. Energy **51** 146, (2018). doi: 10.1016/j.nanoen.2018.06.062
10. Tadesse S. A. and Li M., Nat. Commun. **5** (1), 5402 (2014). doi: 10.1038/ncomms6402
11. Sohn D. B., Kim S. and Bahl G., Nat. Photonics **12** (2), 91 (2018). doi: 10.1038/s41566-017-0075-2
12. Fan L., Sun X., Xiong C., Schuck C. and Tang H. X., Appl. Phys. Lett. **102** (15), 153507 (2013). doi: 10.1063/1.4802250
13. Xiong C., Sun X., Fong K. Y. and Tang H. X., Appl. Phys. Lett. **100** (17), 171111 (2012). doi: 10.1063/1.4707898
14. Bray K. R., Wu R. L. C., Fries-Carr S. and Weimer J., Thin Solid Films **518** (1), 366 (2009). doi: 10.1016/j.tsf.2009.06.052
15. Akhmedov A. K., Murliev E. K., Asvarov A. S., Muslimov A. E. and Kanevsky V. M., Coatings **12** (10), 1583 (2022). doi: 10.3390/coatings12101583
16. Singha A. V., Chandraa S., Srivastava A. K., Chakroborty B. R., Sehgal G., Dalai M. K. and Bose G., Appl. Surf. Sci. **257** 9568 (2011). doi: 10.1016/j.apsusc.2011.06.065
17. Ait Aissa K., Achour A., Elmazria O., Simon Q., Elhosni M., Boulet P., Robert S. and Djouadi M. A., J. Phys. D: Appl. Phys. **48**, 145307 (2015). doi: 10.1088/0022-3727/48/14/145307
18. Khoshman J. M. and Kordesch M. E., J. Non-Cryst. Solids. **351**, 3334 (2005). doi: 10.1016/j.jnoncrysol.2005.08.009
19. Hassine N. B., Mercier D., Renaux Ph., Parat G., Basrour S., Waltz P., Chappaz C., Ancey P. and Blonkowski S., J. Appl. Phys. **105** 044111 (2009). doi: 10.1063/1.3081977.
20. Véliz B. and Orpella A., S. Bermejo, Nanotechnology **30**, 405702 (2019). doi: 10.1088/1361-6528/ab2d58