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Characteristics of MIS structures with Al_2O_3/SiO_x dielectric layers grown on the surface of HgCdTe epitaxial layer

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Atomic layer deposition of thin dielectric films on the surface of mercury cadmium telluride (HgCdTe) draws significant attention being promising passivation technique for infrared FPA detectors fabrication. This study is aimed to investigate methods of lowering interface states densities, built-in charge in the dielectric, and presence of slow traps in the grown layers for three variations of dielectrics, including Al_2O_3 and SiO_x. It was shown that deposition of an additional SiO_x layer on top of Al_2O_3 leads to the reduction of effective accumulated charge density, as well as the charge density associated with slow traps, to values of 4.6×10^{11} cm^{-2} and -5.3×10^{10} cm^{-2}, respectively. The possibility of eliminating the hysteresis effect in the capacitance–voltage characteristics of MIS structures at a certain SiO_x/Al_2O_3 thickness ratio is predicted.

Keywords: HgCdTe, Al_2O_3, atomic-layer deposition, surface passivation, MIS structure, capacitance-voltage curves.

REFERENCES

1. Rogalski A., Antoszewski J., and Faraone L., J. Appl. Phys. **105**, 091101 (2009).
2. Lei W., Antoszewski J., and Faraone L., Appl. Phys. Rev. **2**, 041303 (2015).
3. Rogalski A., Rep. Prog. Phys. **68** (10), 2267–2336 (2005).
4. Iakovleva N. I., Boltar K. O., Burlakov I. D., and Startsev V. V., Advances in Applied Physics **13** (5), 378–419 (2025) [in Russian].
5. Akimov V. M., Boltar K. O., Burlakov I. D., Klimanov Ye. A., Mansvetov N. G., Ponomarenko V. P., Saginov L. D., Solyakov V. N., Stafeev V. I., Timofeev A. A., and Filachev A. M., Applied Physics, № 2, 7–15 (2005) [in Russian].
6. Golovin S. V. and Kashuba A. S. Method of passivating surface of cadmium-mercury telluride. Patent for invention № 2611211 (RF). 2017.
7. Permikina E. V. and Kashuba A. S., Advances in Applied Physics **5** (5), 493–499 (2016) [in Russian].
8. Profijt H. B., Potts S. E., van de Sanden M. C. M., Kessels W. M. M., J. Vac. Sci. Technol. A. **29**, 050801 (2011).
9. Arts K., Hamaguchi S., Ito T., Karahashi K., Knoops H. C. M., Mackus A. J. M., and Kessels W. M. M., Plasma Sources Sci. Technol. **31**, 103002 (2022).
10. Fu R. and Pattison J., Opt. Eng. **51**, 104003 (2012).
11. Zhang P., Ye Z.-H., Sun C.-H., Chen Y.-Y., Zhang T.-N., Chen X., Lin C., Ding R.-G., and He L., J. Electron. Mater. **45** (9), 4716–4720 (2016).
12. Kovchavtsev A. P., Sidorov G. Yu., Nastovjak A. E., Tsarenko A. V., Sabinina I. V., Vasilyev V. V., J. Appl. Phys. **121**, 125304 (2017).
13. Gorshkov D. V., Sidorov G. Yu., Sabinina I. V., Sidorov Yu. G., Marin D. V., and Yakushev M. V., Tech. Phys. Lett. **46** (8), 741–744 (2020).
14. Kashuba A. S., Golovin S. V., Boltar K. O., Permikina E. V., and Atrashkov A. S., Applied physics, № 4, 76–79 (2014) [in Russian].
15. Kim S., Lee S.-H., Jo I. H., Seo J., Yoo Y.-E., and Kim J. H., Sci. Rep. **12**, 5124 (2022).
16. Schroder D. K. Semiconductor Material and Device Characterization. Hoboken: John Wiley & Sons, Inc., 2015.
17. Sze S. M. Physics of Semiconductor Devices. Hoboken: John Wiley & Sons, Inc., 2007.
18. Hansen G. L., Schmit J. L., and Casselman T. N., J. Appl. Phys. **53**, 7099–101 (1982).
19. Voitsekhovskii A. V., Gorn D. I., Izhnin I. I., Izhnin A. I., Goldin V. D., Mikhailov N. N., Dvoretskii S. A., Sidorov Yu. G., Yakushev M. V., and Varavin V. S., Russ. Phys. J. **55**, 910–916 (2013).
20. Voitsekhovskii A. V., Nesmelov S. N., and Dzyadukh S. M., Russ. Phys. J. **58**, 540–551 (2015).

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