

PACS: 85, 85.60.–q

Infrared photosensorics based on hybrid monolithic arrays on quantum dots

V. S. Popov^{1,2}, V. P. Ponomarenko^{1,2}, A. I. Dirochka¹ and S. V. Popov^{3,4}

¹ Orion R&P Association
9 Kosinskaya str., Moscow, 111538, Russia

² Moscow Physical and Technical Institute (MIPT)
9 Institutskii al., Dolgoprudny, Moscow Region, 141700, Russia

³ Shvabe Holding
176 Prospekt Mira, Moscow, 129366, Russia

⁴ Peoples' Friendship University of Russia
3 Ordzhonikidze, Moscow, 115419, Russia

Received 12.11.2024; revised 29.11.2024; accepted 12.12.2024

Hybrid monolithic IR arrays based on colloidal quantum dots (CQD) have been actively developing in the last few years. The dynamics of development and the parameters achieved to date in terms of pitch, maximum format and low cost allow us to say that this direction can ensure the mass distribution of IR cameras of this type in various areas where the use of classic hybrid arrays photodetectors was unavailable. The article is devoted to the basic issues of constructing such arrays, analyzing advanced achievements in this area and forecasting possible applications that are opening up for IR photosensors based on CQD.

Keywords: photosensor; IR array; colloidal quantum dots; CQD; hybrid monolithic array.

REFERENCES

1. Ponomarenko V. P., Popov V. S. and Popov S. V., J. Commun. Technol. Electron **67**, S1–S36 (2022). doi: 10.1134/S106422692213006X 7
2. Popov V. S., Ponomarenko V. P. and Popov S. V., Applied Physics, № 6, 45–53 (2023) [in Russian]. doi: 10.51368/1996-0948-2023-6-45-53
3. Ponomarenko V. P., Popov V. S., Shuklov I. A. et al., Russ. Chem. Rev. **93**, RCR5113 (2024). doi: 10.59761/RCR5113
4. Caillas A. and Guyot-Sionnest P., ACS Nano **18**, 8952–8960 (2024). doi: 10.1021/acsnano.3c12581
5. Xue X., Hao Q. and Chen M., Light. Sci. Appl. **13**, 89 (2024). doi: 10.1038/s41377-024-01436-y
6. (2023) Acuros SWIR VISION. <https://www.swirvisionsystems.com/acuros-swir-camera/>.
7. (2024) SWIR VISION Acuros® GO. <https://www.swirvisionsystems.com/acuros-go-camera/>.
8. Gréboval C., Darson D., Parahyba V. et al., Nanoscale **14**, 9359–9368 (2022). doi: 10.1039/D2NR01313D
9. (2024) Emberion Oy Introduces Groundbreaking Ultra Low-Cost SWIR Sensor. In: Emberion Oy. <https://www.emberion.com/emberion-oy-introduces-groundbreaking-ultra-low-cost-swir-sensor/>.
10. (2023) About. SWIR Vision Systems. <https://www.swirvisionsystems.com/about/>.
11. Jagtap A., Goubet N., Livache C. et al., J. Phys. Chem. C **122**, 14979–14985 (2018). doi: 10.1021/acs.jpcc.8b03276
12. Tang X., Ackerman M. M. and Guyot-Sionnest P., ACS Nano **12**, 7362–7370 (2018). doi: 10.1021/acsnano.8b03871
13. Dong R., Bi C., Dong Q. et al., Adv. Opt. Mater. **2**, 549–554 (2014). doi: 10.1002/adom.201400023
14. Clifford J. P., Konstantatos G., Johnston K. W. et al., Nat. Nanotechnol. **4**, 40–44 (2009). doi: 10.1038/nnano.2008.313
15. Lee J. W., Kim D. Y. and So F., Adv. Funct. Mater. **25**, 1233–1238 (2015). doi: 10.1002/adfm.201403673
16. Popov V. S., Ponomarenko V. P., Dymkin D. V. et al., Dokl. Phys. **68**, 233–236 (2023). doi: 10.1134/S1028335823070066
17. Liu J., Liu P., Chen D. et al., Nat. Electron. **5**, 443–451 (2022). doi: 10.1038/s41928-022-00779-x
18. Georgitzikis E., Malinowski P. E., Li Y. et al., IEEE Sens. J. **20**, 6841–6848 (2020). doi: 10.1109/JSEN.2019.2933741
19. Leemans J., Pejović V., Georgitzikis E. et al., Adv. Sci. **9**, 1–8 (2022). doi: 10.1002/advs.202200844
20. Gong W., Wang P., Deng W. et al., IEEE Trans Electron Devices **70**, 3668–3674 (2023). doi: 10.1109/TED.2023.3276730
21. Klem E. J. D., Gregory C. W., Cunningham G. B. et al., Appl. Phys. Lett. (2012). doi: 10.1063/1.4707377
22. (2023) Emberion VS20 Vis-SWIR Camera Series. <https://www.emberion.com/products/vs20-vis-swir-camera/>.
23. Malinowski P., Pejovic V., Bentell J. et al., AMA Service GmbH 121–122 (2023).
24. Steckel J. S., Josse E., Pattantyus-Abraham A. G. et al., IEEE Int. Electron Devices Meet. IEEE 23.4.1–23.4.4 (2021).
25. Al-Kuhaili M. F., J. Mater. Sci. Mater. Electron. **31**, 2729–2740 (2020). doi: 10.1007/s10854-019-02813-9
26. Zhou C., Zhou H., He Y. et al., Trans Tianjin Univ. **25**, 195–200 (2019). doi: 10.1007/s12209-018-0153-7
27. Steckel J. S., Arnaud J., Pattantyus-Abraham A. G. et al. Colloidal Quantum Dot Image Sensor Technology. B: Int. Conf. Compd. Semicond. Manuf. Technol. Orlando, 2023, pp. 6–9.
28. Lee J., Georgitzikis E., Li Y. et al., IEEE Int. Electron Devices Meet. IEEE 16.5.1–16.5.4 (2020).
29. Pejovic V., Lee J., Georgitzikis E. et al., IEEE Electron. Device. Lett. **42**, 1196–1199 (2021). doi: 10.1109/LED.2021.3093081
30. Hinds S., Klem E., Gregory C. et al. Proc. SPIE. Infrared Technology and Applications, 2020, Vol. XLVI, p. 8.
31. Luo Y., Tan Y., Bi C. et al., APL Photonics (2023). doi: 10.1063/5.0145374
32. (2024) 200 mm wafer level processing of QDot™ quantum dot n-type ink. In: Quantum Solut. <https://quantum-solutions.com/news/wafer-level-processing-of-qdot-quantum-dot-n-type-ink/>.
33. Cam TQ, Dot Q (2024) Q . Cam™ SWIR Camera. Quantum Solut 0–3.
34. (2024) Q . Fly™ Camera. In: Quantum Solut. <https://quantum-solutions.com/product/q-fly-camera/>.
35. (2024) Topodrone and Quantum Solutions announce collaboration on next generation Vis-SWIR camera. In: Topodrone. <https://topodrone.com/company/news/1479/>.