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Investigation of ligand exchange in thin films of PbS colloidal quantum dots with FTIR-spectroscopy

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Thin films were prepared from PbS colloidal quantum dots with oleate ligand shell and mean size of 7.3 nm. Rate of the ligand exchange by iodide-ions in thin film of PbS CQDs was studied for the first time in various solvents applying HATR-FTIR spectroscopy. Modification of ligand shells of PbS CQDs in thin films by interaction with some solvents and solutions of thioisocyanate wasinvestigated and analyzed. It was demonstrated the ability of formamide to replace oleate ligands in PbS CQDs.

Keywords: lead sulfide, ligand exchange, IR-Fourier spectroscopy, quantum dots.

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REFERENCES

1. V. P. Ponomarenko, V. S. Popov and S.V. Popov, Usp. Prikl. Fiz. **9** (1), 25 (2021).
2. I. A. Shuklov and V. F. Razumov, Russ. Chem. Rev. **89** (3), 379 (2020).
3. S. Hinds et al., Extended SWIR high performance and high definition colloidal quantum dot imagers. Infrared Technology and Applications XLVI. SPIE **11407**, 11–19 (2020).
4. M. Albaladejo-Siguan, E. C. Baird, D. Becker-Koch, Y. Li, A. L. Rogach and Y. Vaynzof, Advanced Energy Materials **11** (12), 2003457 (2021).
5. S. Mourdikoudis, R. M. Pallares and N. T. K. Thanh, Nanoscale **10**, 12871 (2018).
6. Z. Hens and J. C. Martins, Chemistry of Materials **25**, 1211 (2013).
7. Á. I. López-Lorente and B. Mizaikoff, TrAC Trends in Analytical Chemistry **84**, 97 (2016).
8. D. D. Sarma, P. K. Santra, S. Mukherjee and A. Nag, Chem. Mater. **25**, 1222 (2013).
9. I. D. Skurlov, I. G. Korzhenevskii, A. S. Mudrak, A. Dubavik, S. A. Cherevkov, P. S. Parfenov, X. Zhang, A. V. Fedorov, A. P. Litvin and A. V. Baranov, Materials **12** (19), 3219 (2019).
10. D. M. Balazs, D. N. Dirin, H.-H. Fang, L. Protesescu, G. H. ten Brink, B. J. Kooi, M. V. Kovalenko and M. A. Loi, ACS Nano **9** (12), 11951 (2015).
11. Q. Lin, H. J. Yun, W. Liu, H.-J. Song, N. S. Makarov, O. Isaienko, T. Nakotte, G. Chen, H. Luo, V. I. Klimov and J. M. Pietryga, J. Amer. Chem. Soc. **139** (19), 6644 (2017).
12. X. Tong, J. Wu and Z. M. Wang, *Quantum Dot Photodetectors*. (Springer International Publishing, 2021).

13. J. H. Joo, R. Merkle and J. E. Maier, Journal of Power Sources **196**, 7495 (2011).
14. B.-S. Kim, J. Hong, B. Hou, Y. Cho, J. I. Sohn, S. Cha and J. M. Kim, Applied Physics Letters **109** (6), 063901 (2016).
15. J. Boekker, *Spectroscopie*. (Vogel Industrie Medie GmbH, Wuerzburg, 1997).
16. I. A. Mudunkotuwa, A. A. Minshid and V. H. Grassian, Analyst. **139** (5), 870 (2014).
17. A. G. Young, N. Al-Salim, D. P. Green and A. J. McQuillan, Langmuir **24** (8), 3841 (2008).
18. I. A. Shuklov, V. F. Toknova, A. A. Lizunova and V. F. Razumov, Materials Today Chemistry **18**, 100357 (2020).
19. R. A. Ganeev, I. A. Shuklov, A. I. Zvyagin, D. V. Dyomkin, S. I. Bocharova, V. S. Popov, V. F. Toknova, A. A. Lizunova, O. V. Ovchinnikov and V. F. Razumov, Optical Materials **121**, 111499 (2021).
20. I. A. Shuklov, V. F. Toknova, D. V. Demkin, G. I. Lapushkin, L. M. Nikolenko, A. A. Lizunova, S. B. Brichkin, V. N. Vasilets and V. F. Razumov, High Energy Chemistry **54** (3), 183 (2020).
21. A. T. Fafarman, W.-K. Koh, B. T. Diroll, D. K. Kim, D.-K. Ko, S. J. Oh, X. Ye, V. Doan-Nguyen, M. R. Crump, D. C. Reifsnyder, C. B. Murray and C. R. Kagan, J. Amer. Chem. Soc. **133** (39), 15753 (2011).
22. A. Hassinen, I. Moreels, K. De Nolf, P. F. Smet, J. C. Martins and Z. Hens, J. Amer. Chem. Soc. **134** (51), 20705 (2012).
23. A. Nag, M. V. Kovalenko, J.-S. Lee, W. Liu, B. Spokoyny and D. V. Talapin, J. Amer. Chem. Soc. **133** (27), 10612 (2011).