

## Unveiling the electronic structure of Zinc Selenide Quantum Dots with X-ray Spectroscopy

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Semiconductor quantum dots (QDs) are a unique class of materials exhibiting size-dependent optical and electronic properties due to the quantum confinement effect. These features make QDs promising candidates for high-performance optoelectronic applications, such as light-emitting diodes and solar cells. Among various semiconductors, zinc selenide (ZnSe) emerged as a potential candidate for next-generation QD-based technologies. However, the electronic properties of ZnSe QDs are significantly influenced by surface and defect effects, which remain inadequately understood.

In this study, we show the application of X-ray spectroscopy techniques to explore defect states in ZnSe QDs. A series of ZnSe QD suspensions with varying particle sizes were analyzed using a laboratory-based X-ray spectrometer [1] equipped with a custom liquid sample cell [2]. This setup enabled simultaneous collection of Zn K-edge absorption and Zn K $\alpha$  emission spectra. Additional Zn K-edge X-ray absorption spectroscopy (XAS) measurements were performed at the ASTRA beamline of the SOLARIS National Synchrotron Radiation Centre, which provided a more intense X-ray source.

The results, supported by theoretical calculations and time-resolved optical transient spectroscopy, provided a comprehensive assessment of the influence of defect states on the size-dependent properties of ZnSe QDs. Additionally, performed XAS experiments allowed evaluation of the capabilities of laboratory-based X-ray spectroscopy as the complementary tool in material science.

**Acknowledgements:** This project was financed by the National Science Centre (Poland) under grant number 2020/37/B/ST3/00555

### References

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2. R. Fanselow et al., Spectrochimica Acta Part B: Atomic Spectroscopy 189 (2022) 1063673.