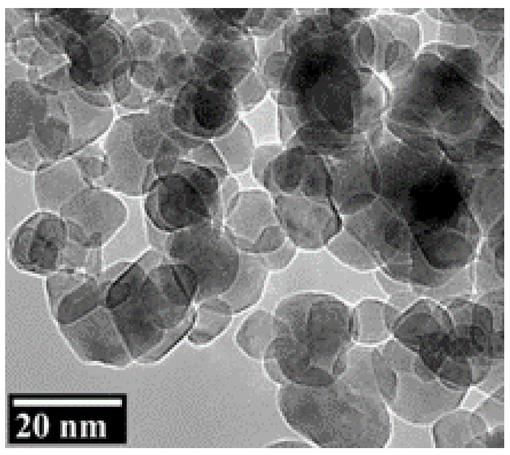
Micro- and nanocomposites of barium zirconate incorporated in polymer matrix

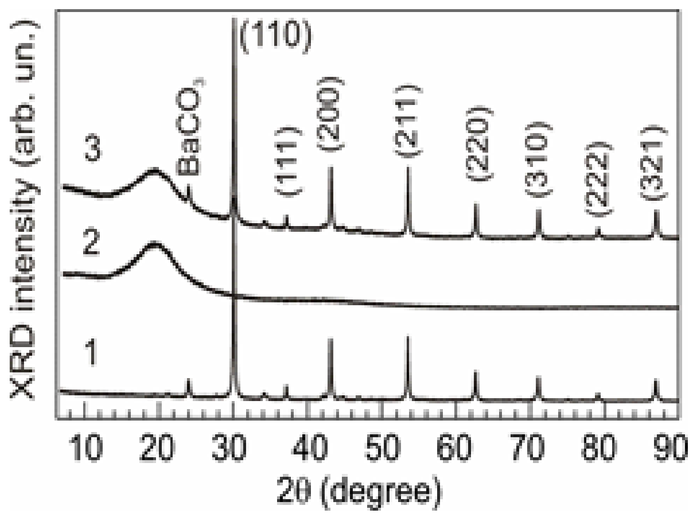
Aksimentyeva O.I.[1], **Horbenko Yu.Yu.**[1], **Savchyn V.P.**, **Demchenko P.Yu.**[1], **Popov A.I.**[2]

[1] *Ivan Franko National University of Lviv, olena.aksimentyeva@lnu.edu.ua*
[2] *Institute of Solid-State Physics, University of Latvia, Riga, Latvia*

BaZrO3 (BZO) has found several interesting applications, such as substrate for the superconductors, as high temperature microwave dielectric, as fluorescent dots. The luminescence characteristics depend on the fabrication technology of micro- and nano-crystal materials [1]. We studied the irradiative properties and structure of hybrid composites based on polystyrene (PS) and micro- (d < 10 μm) and nanocrystals (d < 50 nm) of BZO using cathode luminescent (CL) spectroscopy and X-ray analysis.



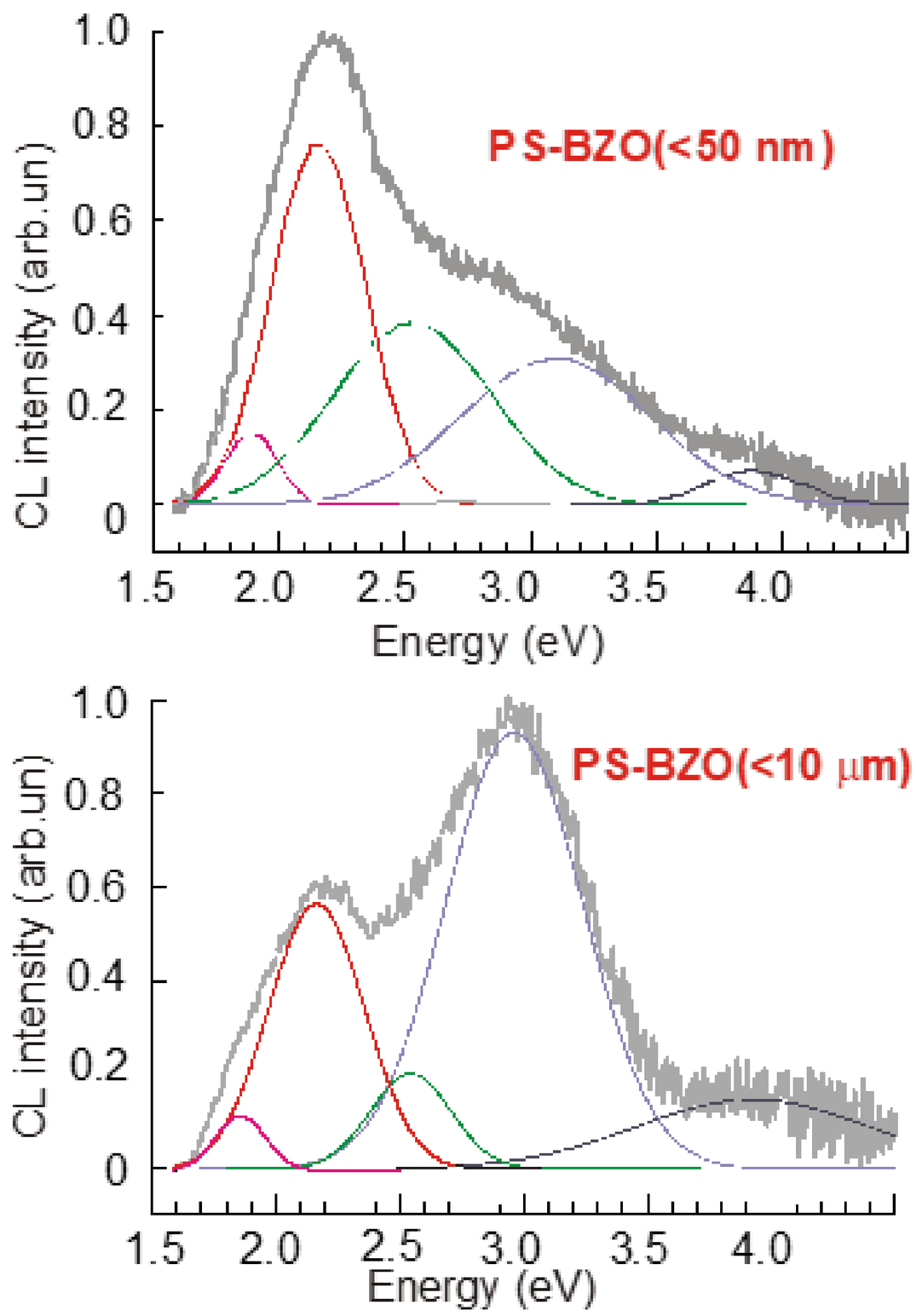
TEM image of $BaZrO_3$ nanocrystals



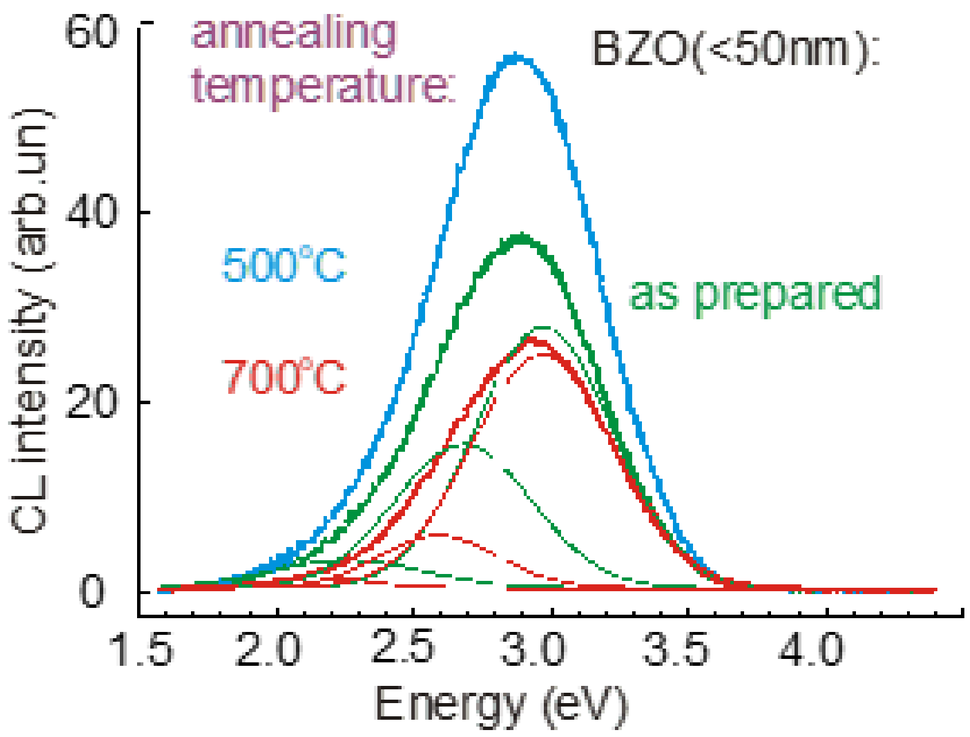
Experimental diffractogram of $BaZrO_3$ (*1*), PS (*2*), PS–BaZrO3 (10%) composite (*3*)

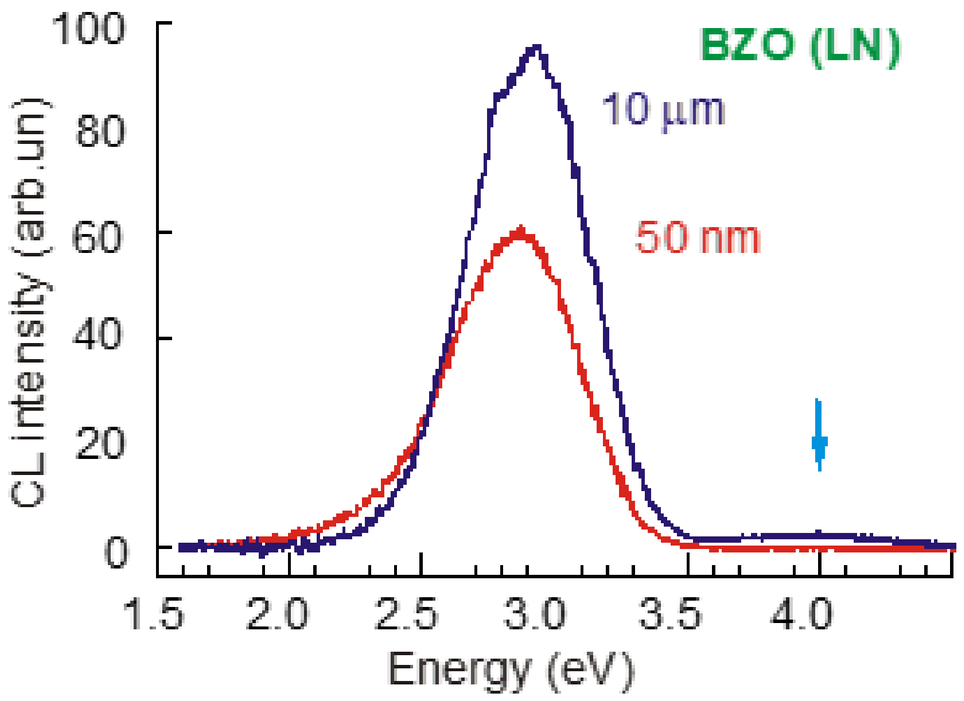
By XPD analysis it is found that $BaZrO_3$ presents a cubic perovskite - type structure in the crystalline form with space group *Pm_3m.* The lattice parameter a for at room temperature is 4.19083 6) Å, average size of domains is 22.6 nm. In composite the lattice parameter "*a*" for BZO decreases from 4.19083(6) Å, to 4.1879(2) Å, but micro structural parameters remain practically unchanged.

CL data of PS-BZO nano- and micro-composites



Temperature dependences of CL spectra





For the BZO-PS composites, a significant reduction of the CL intensity is observed. At the same time, the low-energy and high-energy bands (near 4 eV) appeared due to change in the BZO structure under the influence of polymer. For the composite of BZO nanocrystals – PS it is observed a strong increase of the intensity in the range of small angles of diffraction 2Θ<2.0°, indicating the formation of fractal aggregates and structures.

The ratio between the intensities of the "red" and "blue" CL bands depends on grain size of BZO.

Acknowledgments

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References

1. *Panzer M. J., Aidala K. E., Bulović V.* // Nano Rev.-2012.-3.-16144.
2. *Savchyn V. P., Popov A. I., Aksimentyeva O. I. et al.* // Low Temp. Phys.-2016.-42, N 7.-P. 597-600.