26 - 30 June 2023
Belgrade, Serbia

21. СИМПОЗИЈУМ ФИЗИКЕ КОНДЕНЗОВАНЕ МАТЕРИЈЕ

THE 21st SYMPOSIUM ON CONDENSED MATTER PHYSICS

BOOK OF ABSTRACTS

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Vinca Institute of Nuclear Sciences
University of Belgrade, Faculty of Physics
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Ministry of Science, Technological Development and Innovation

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How Can We Benefit From The Optical Properties Of Mn^{5+} To Make Pigments And Near-Infrared Phosphors?

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Abstract. When tetrahedrally coordinated in crystals, Mn^{5+} optical centers ([Ar]$3d^2$ electron configuration) always encounter a strong crystal field. Their lower electronic states have an energy progression of $^3A_2 < {}^1E < {}^1A_1 < {}^3T_2 < {}^3T_1$. The ground state ($^3A_2$) is not orbitally degenerate, and the first excited state ^1E has almost no nuclear displacement relative to the ground state and can be separated by the low-symmetry ligand field. For these reasons, Mn^{5+}-doped compounds may provide a strong and narrow (FHWM < 5 nm) phosphorescence emission in the near-infrared (1110–1300 nm) which is significantly affected by a nephelauxetic effect. Their strong absorption in the red spectral region, associated with the $^3A_2 \rightarrow {}^3T_1({}^3F)$ electronic transition, provides intensive turquoise/blue coloration of the materials. Herein, we propose the way to engineer pigments and efficient near-infrared phosphors and demonstrate optical properties of several of them (Mn^{5+}-activated $Ca_6Ba(PO_4)_4O$ [1], $Sr_3(PO_4)_2$, $Ba_3(PO_4)_2$, and $Ba_3(VO_4)_2$). In addition, recent applications of these materials are highlighted, including luminescence thermometry [2] based on phosphors steady-state [1] and time-resolved [3] near-infrared emission, the latter of which has been demonstrated for biomedical applications.

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