Luminescence properties of $ACaF_3$ (A=K, Rb, Cs) doped with Pr^{3+} ions

Alexander Grippa[1], Patrycja Zdeb[2], Anatoliy Voloshinovskii[3], Andriy Pushak[4]
Przemysław Jacek Dereń[2], Nadiia Rebrova[2#]

[1] Institute for Scintillation Materials, National Academy of Sciences of Ukraine,
Nauky Avenue 60, 61072 Kharkov, Ukraine
[2] Institute of Low Temperature and Structure Research, Polish Academy of Science,
Okólna Street 2, 50-422 Wrocław, Poland
[3] Ivan Franko National University of Lviv, 8 Kyryla i Mefodiya St, 79000, Lviv, Ukraine
[4] Ukrainian Academy of Printing, Pidholosko st., 19, Lviv, Ukraine

Research continues to develop new phosphors capable of emitting light across a broad spectrum, from ultraviolet (UV) to infrared, with potential applications in a variety of fields. In this context, praseodymium has garnered attention for its ability to emit across the entire spectrum, influenced by the interaction between the lattice host and Pr^{3+} ions. This interaction results in desirable optical properties due to the energy configuration of the $4f^15d^1$ state in relation to the $4f^2$ levels and the conduction band's ground states. For example, materials where E(4f5d) is lower than E($^1S_0$) and only 4f5d-4f interconfiguration transitions are observed can be utilized as ultraviolet phosphors, scintillators, and light upconverters. In contrast, materials where E(4f5d) is higher than E($^1S_0$) and only the 4f-4f transition occurs can be used as photon cascade emitters.
The luminescent properties of $ACaF_3$ (A=K, Rb, Cs) perovskites doped with various rare earth metals, such as Eu^{2+}, Yb^{3+}, Gd^{3+}, Nd^{3+}, Dy^{3+}, Sm^{3+}, and Ce^{3+}, were intensively studied. Almost no attention was paid to Pr^{3+} activated $ACaF_3$ (A=K, Rb, Cs) hosts. In this work, the new phosphors $ACaF_3$:Pr^{3+} (A=K, Rb, Cs) were synthesized using solid state reactions. Luminescent properties in ultraviolet and visible ranges were investigated. Information on the prospects for using $ACaF_3$ Pr^{3+} (A=K, Rb, Cs) as scintillators will be discussed.

Acknowledgments: This work was supported by The National Science Centre (NCN) under the Miniatura 7 project, grant no. 2023/07/X/ST5/00965, which is gratefully acknowledged. A. Grippa (Oleksandr Gryppa) is supported by Visegrad Fellowship #62410067.

corresponding author: n.rebrova@intibs.pl