Optical properties of praseodymium concentrated phosphates

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The optical properties of Pr³⁺ ions in concentrated cyclotetraphosphates M¹PrP₄O₁₂ (M¹ = Cs, Rb) and cyclotriphosphate PrP₃O₉.3H₂O have been investigated. Emission spectra under selective laser excitation in the ³P₃ multiplets (J = 0, 1, 2) have been measured both at room and low temperatures. The resulting fluorescent emissions originate mainly from the ³P₀ level. They exhibit very fast exponential decays with decay-times shorter than 100 ns at 6K. The results concerning cyclotetraphosphates are compared with those obtained for the corresponding polyphosphates M¹Pr (PO₃)₄ (M¹ = Cs, Rb) with the aim of understanding the possible role of the cyclic structure. In the same way, the results concerning the hydrated cyclotriphosphate are compared with those obtained for the corresponding anhydrous polyphosphate Pr (PO₃)₃ in order to point out the role of water molecules. The phosphates under consideration (cyclotriphosphate PrP₃O₉.3H₂O excepted) exhibit intense fluorescent emissions under X-ray excitation. These emissions originating from Pr³⁺ 4f₅d→4f² transitions have very short decay-times (less than 10 ns at 6K). Comparing the obtained room temperature emission spectra under X-ray excitation with the corresponding bismuth germanate Bi₄Ge₃O₁₂ spectrum leads to significant relative light yields (67% for CsPrP₄O₁₂). As a result, most of the investigated materials are promising fast scintillators, provided that crystals of good optical quality and appropriate size can be grown.