# Unlocking the Potential of $Pr^{3+}$-Doped Borates in the field of Visible to UVC upconversion

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The luminophores emitting ultraviolet C (UVC) radiation are intensively studied as a replacement for mercury lamps in germicidal applications or as nanoscintilators in alternative X-ray therapy[1]. Praseodymium (Pr)-doped inorganic matrices stand out as promising candidates for this purpose, thanks to their broad and intense emission bands in the 220–280 nm range corresponding to 4f5d → 4f transitions. However, the fundamental practical limitation of these materials is excitation in the ultraviolet (i.e., in the range 120–200 nm), which leads to their solarization. Since the excitation of a host in the visible never produces such defects, we are looking for new matrices that, doped with $Pr^{3+}$, can transform visible light into UVC radiation.

The crucial issue in achieving a UVC phosphor lies in the energy of $Pr^{3+}$ 5d levels, a parameter heavily influenced by the composition and crystal structure of the host lattice. These factors impact the crystal field splitting and centroid shift of the 5d levels [2,3]. By carefully selecting the appropriate host for activator ions, it becomes possible to design phosphor with the desired optical properties.

In this study, we introduce a newly obtained phosphor based on a $Pr^{3+}$-doped borates host. We present its synthesis and optical characterization, with a particular focus on its performance in the UV range. Notably, we observe intense visible-to-UVC upconversion luminescence under 444 nm laser excitation, which we compare to other well-known Vis-to-UVC upconverters. Interestingly, the relative intensity in the 220 – 280 nm range was higher for our material compared to the $Y_2SiO_5$ host. These findings highlight the potential of $Pr^{3+}$-doped borates for germicidal applications, particularly in the creation of self-cleaning surfaces.

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