

# Novel Red-Emitting Nitridoborate: $\text{SrBa}_8(\text{BN}_2)_6:\text{Pr}^{3+}$



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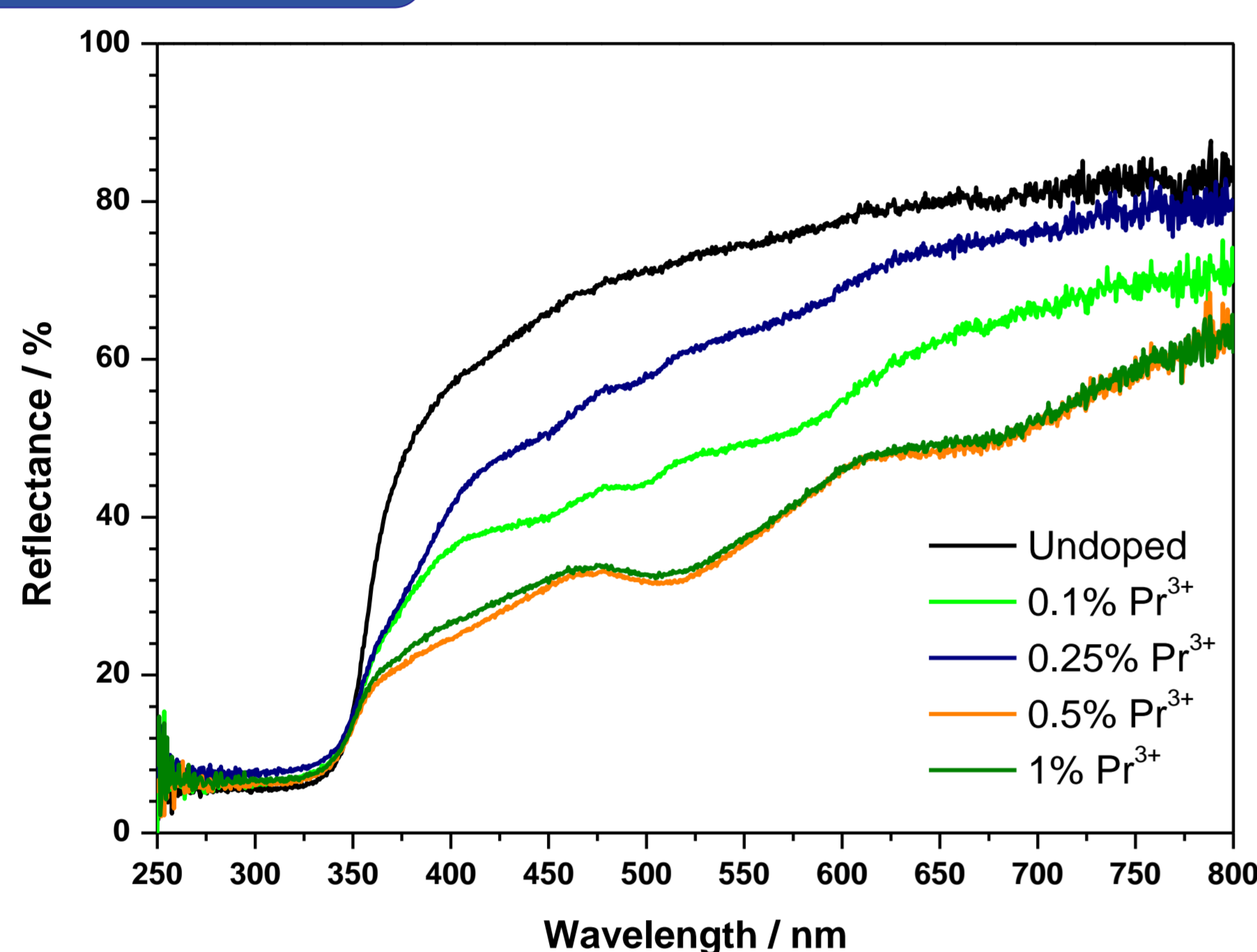
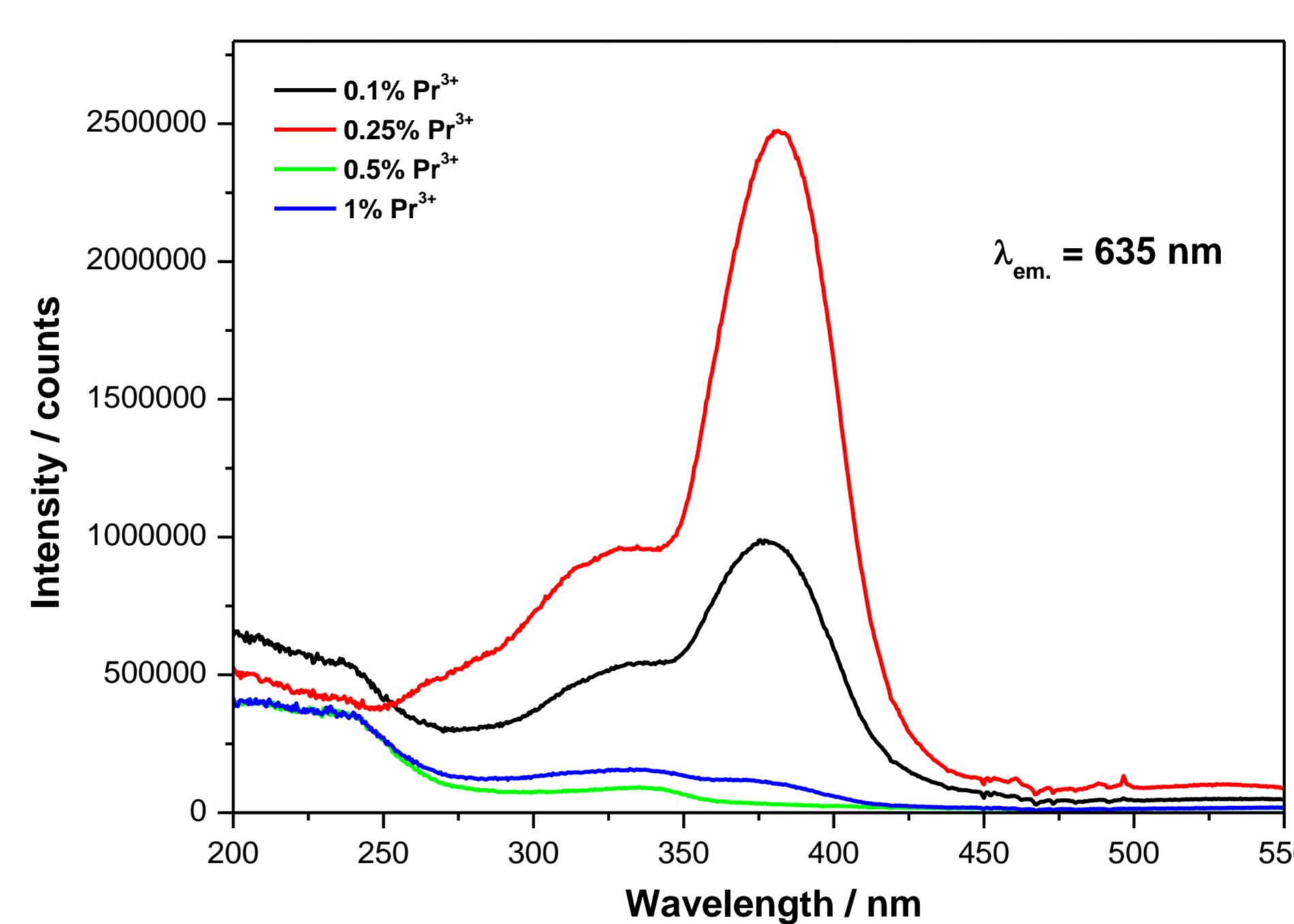
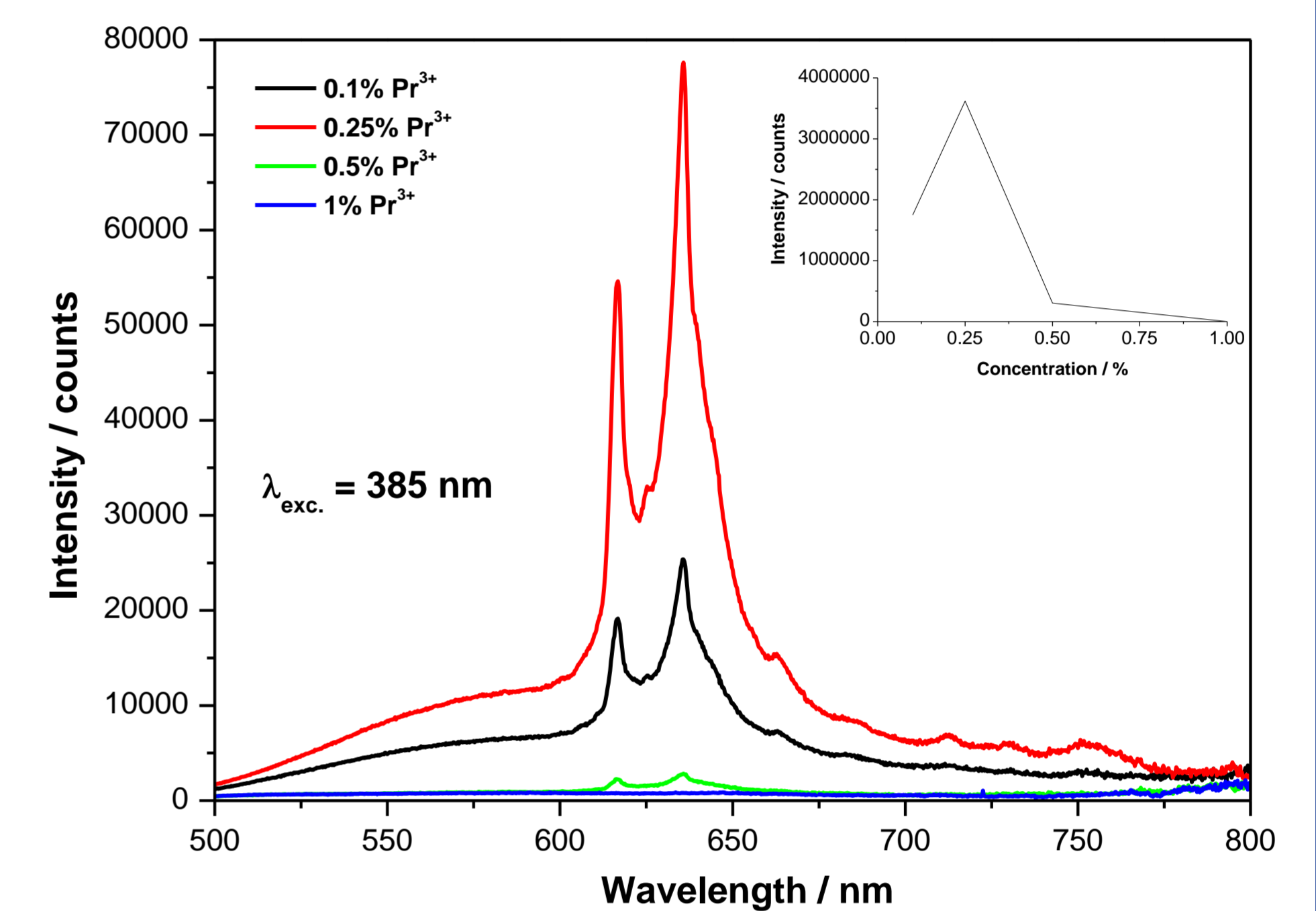
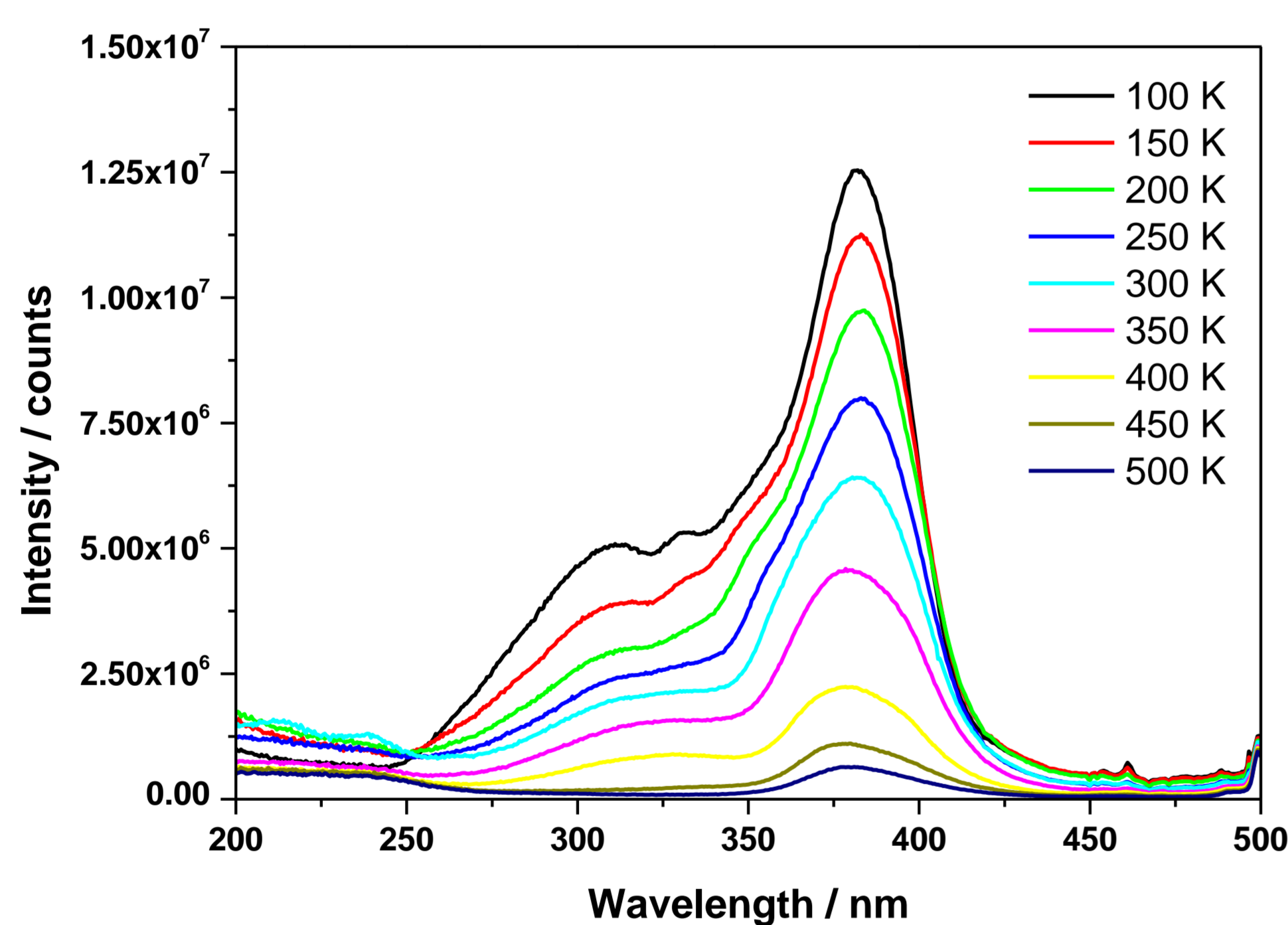
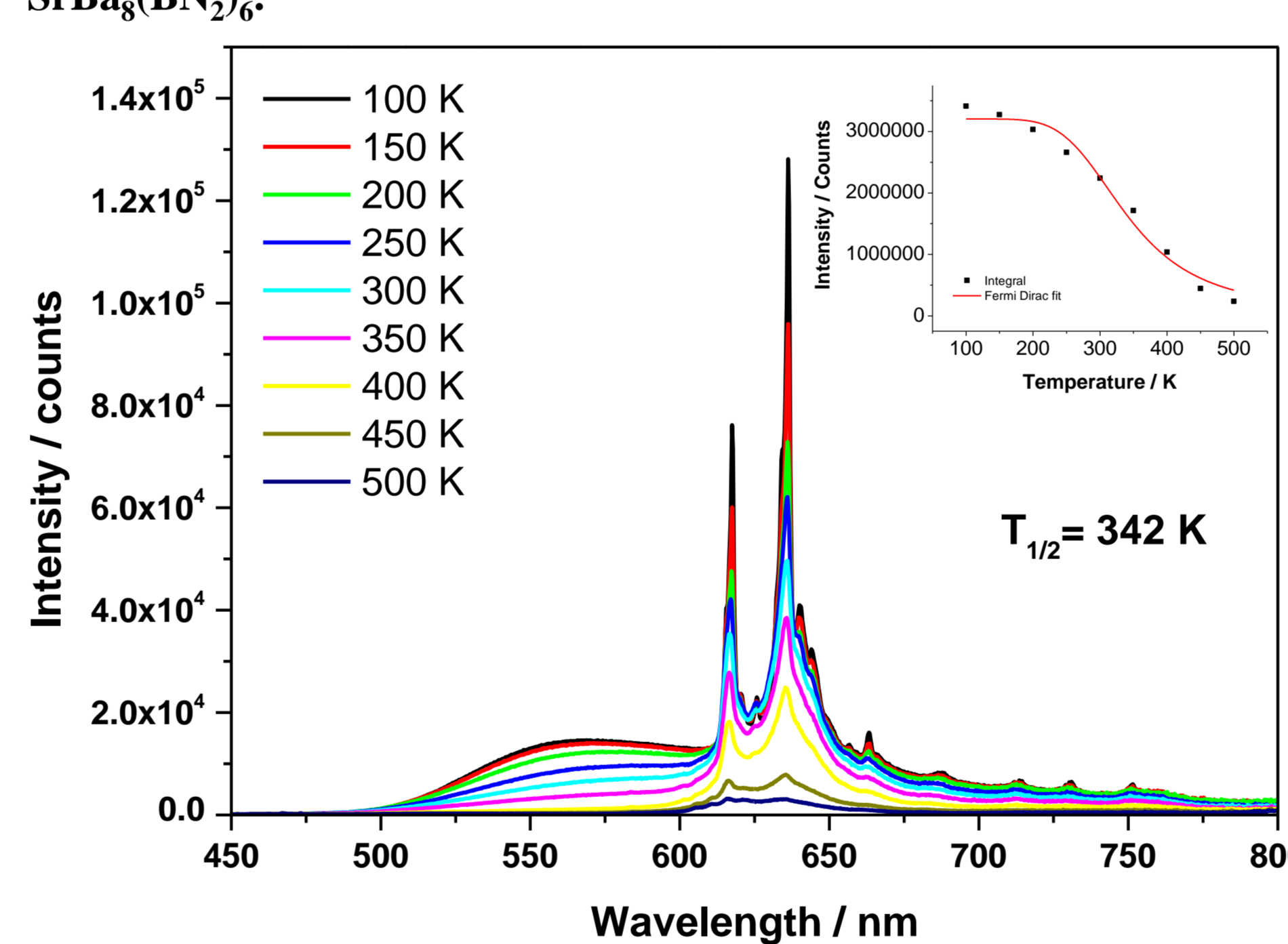
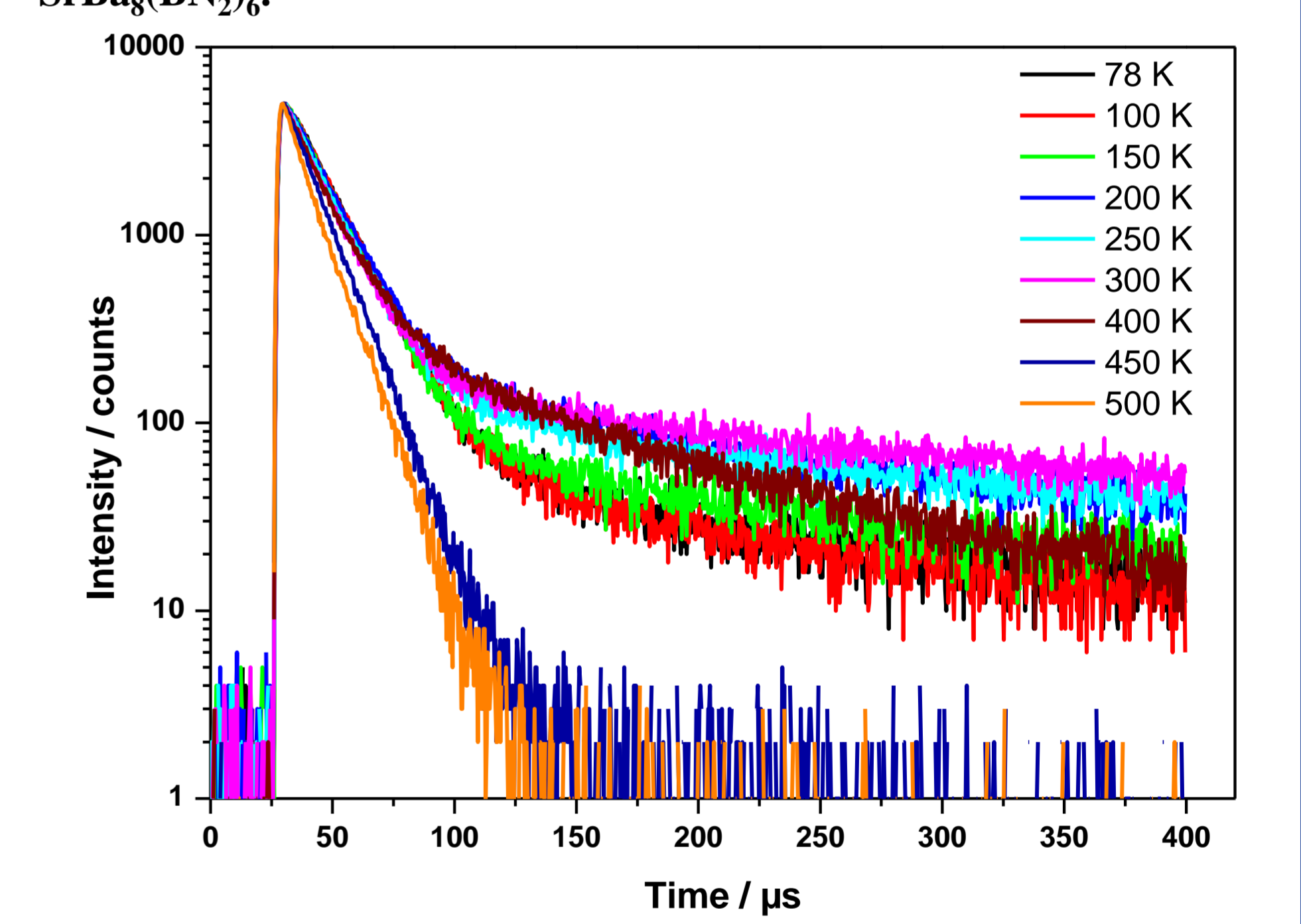
## Introduction

Investigation of nitridoborates started in the early 1960ties by investigations of Gobeau and Anselmet [1]. Since then, nitridoborates of alkali metals, alkaline earth metals and lanthanides have been reported [2-4]. One interesting aspect in nitridoborate chemistry is the versatility of the structural building units, ranging from  $\text{N}^{3-}$ ,  $\text{BN}^x$ ,  $\text{BN}_2^{3-}$ ,  $\text{BN}_3^{6-}$ ,  $\text{B}_2\text{N}_4^{8-}$  to  $\text{B}_3\text{N}_6^{9-}$  and even combinations thereof. Reported properties include catalytic activity and interesting magnetic behavior such as superconductivity in  $\text{La}_2\text{Ni}_2(\text{BN}_2)_2\text{N}$ . However, reports on luminescence in these systems are scarce.

The title compound,  $\text{SrBa}_8(\text{BN}_2)_6$ , was first reported by Somer et al. together with its isostructural analogous,  $\text{EuBa}_8(\text{BN}_2)_6$ , in 2005 [5]. The material crystallizes in a cubic space group ( $Im\bar{3}m$ , no. 229) and features linear  $\text{BN}_2$  units. Due to the air and moisture sensitivity of the starting compounds, Somer et al. synthesized the material in arc-welded niobium containers, while for this study we applied solid-state reactions in BN crucibles under nitrogen gas.

Herein, we report on the new red-emitting compound  $\text{SrBa}_8(\text{BN}_2)_6:\text{Pr}^{3+}$ . In order to gain insight into fundamental photoluminescence (PL) processes, PL spectra, reflectance spectra and decay curves were recorded. Additionally, temperature dependent PL spectra and decay measurements will be presented.

## Results

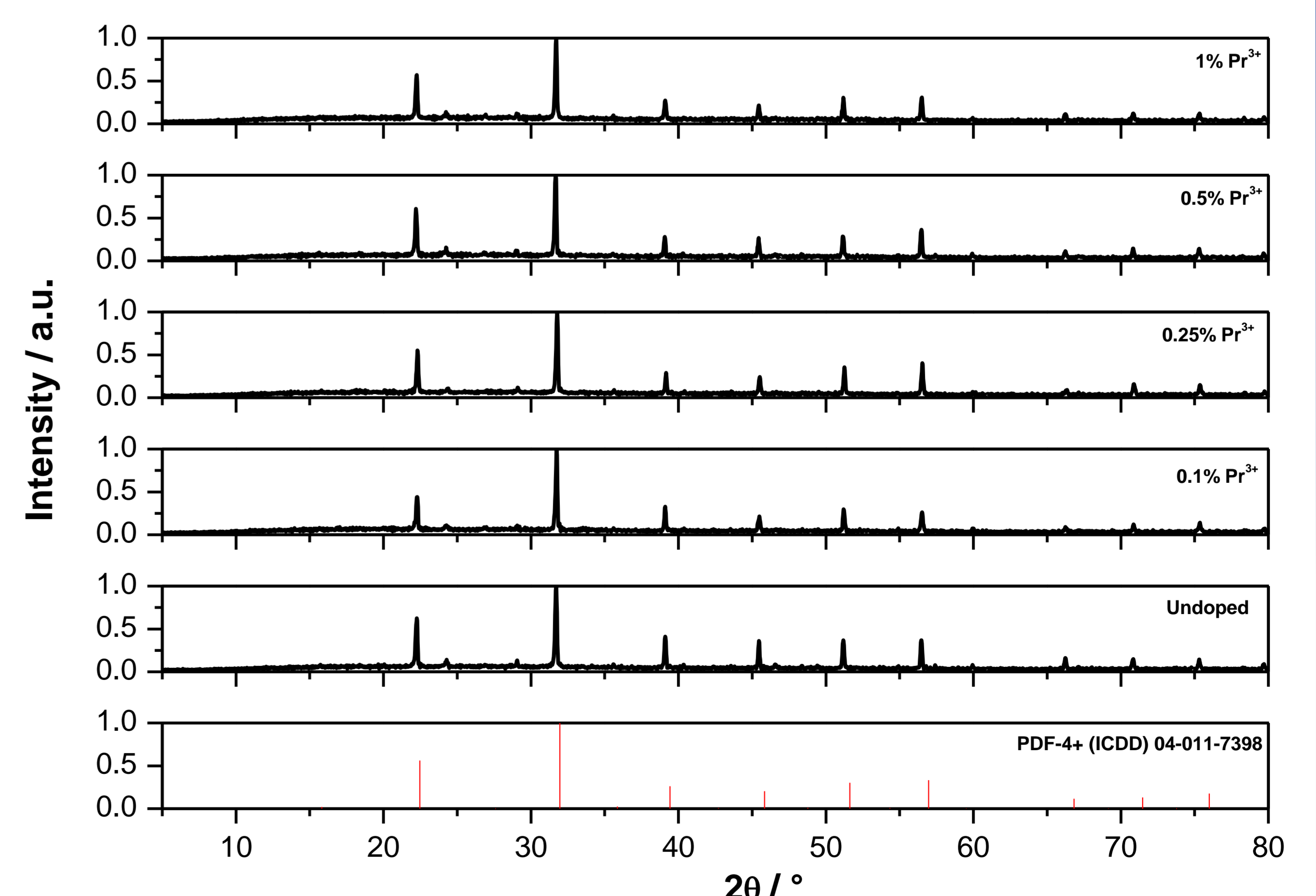

 Figure 1: Reflection spectra of as-prepared  $\text{SrBa}_8(\text{BN}_2)_6$  samples.

 Figure 2: Concentration dependent excitation intensities of  $\text{Pr}^{3+}$  doped  $\text{SrBa}_8(\text{BN}_2)_6$ .

 Figure 3: Concentration dependent emission intensities of doped  $\text{SrBa}_8(\text{BN}_2)_6$ .

 Figure 4: Temperature dependent excitation spectra of as-prepared  $\text{SrBa}_8(\text{BN}_2)_6:\text{Pr}^{3+}$  samples.

 Figure 5: Temperature dependent emission spectra of as-prepared  $\text{SrBa}_8(\text{BN}_2)_6:\text{Pr}^{3+}$  samples.

 Figure 6: Temperature dependent decay curves of as-prepared  $\text{SrBa}_8(\text{BN}_2)_6:\text{Pr}^{3+}$  samples.  $\lambda_{em} = 635 \text{ nm}$  /  $\lambda_{exc} = 385 \text{ nm}$ .

## Conclusions

- Single phase, polycrystalline powder samples of undoped and  $\text{Pr}^{3+}$ -doped  $\text{SrBa}_8(\text{BN}_2)_6$  were successfully synthesized via a solid-state route in a pure nitrogen atmosphere.
- Reflection spectra show greying of doped samples with increasing  $\text{Pr}^{3+}$  concentration, most likely due to charge compensation issues.
- Photoluminescence spectra reveal efficient red emission with a colour point (x: 0.669 y: 0.309) suitable for wide colour gamut displays.
- Decay curves at room temperature are in the range of 16  $\mu\text{s}$  and thus typical for intraconfigurational  $4f-4f$  transitions of  $\text{Pr}^{3+}$ , while at low temperatures an additional component appears which can be interpreted as a sort of afterglow caused by host matrix defects.
- The recorded thermal quenching curves show that PL intensity declines by 50% ( $T_{1/2}$ ) at about 342 K.

## Acknowledgement

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 Figure 7: Powder diffraction patterns of as-prepared phosphor samples. Depicted are undoped and doped samples of  $\text{SrBa}_8(\text{BN}_2)_6$  compared to literature data.