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The Lanthanoid Oxoantimonate(III) Bromides LnSb$_2$O$_4$Br (Ln = Eu –Tb): Synthesis, Crystal Structure and Luminescence

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Pale yellow crystals of LnSb$_2$O$_4$Br (Ln = Eu –Tb) were synthesized via high temperature solid-state reactions from antimony sesquioxide, the respective lanthanoid sesquioxides and tribromides. Single-crystal X-ray diffraction studies revealed a layered structure in the monoclinic space group $P2_1/c$. In contrast to hitherto reported quaternary lanthanoid(III) halide oxoantimonates(III) [1], in LnSb$_2$O$_4$Br the lanthanoid(III) cations are exclusively coordinated by oxygen atoms in the shape of square hemiprisms. These $[LnO_8]^{13-}$ polyhedra form layers parallel to the (100) plane by sharing common edges as shown in Figure 1. All antimony(III) cations are coordinated by three oxygen atoms forming ψ^1-tetrahedral $[SbO_3]^{3-}$ units, which have oxygen atoms in common building up meandering strands along [001] (Figure 2) according to 1D-{$[SbO^v_{2/2}O^t_{1/1}]^-$} (v = vertex-sharing, t = terminal). The bromide anions are located between two layers of these parallel running oxoantimonate(III) strands and have no bonding contacts with the Ln^{3+} cations. Since Sb^{3+} is known to be an efficient sensitizer for Ln^{3+} emission, photoluminescence studies were carried out to characterize the optical properties and assess their suitability as light phosphors. Indeed, for both, GdSb$_2$O$_4$Br and TbSb$_2$O$_4$Br doped with about 1.0 –1.5 at-% Eu^{3+} efficient sensitization of the Eu^{3+} emission could be detected. The resulting luminescence properties of both doped and undoped GdSb$_2$O$_4$Br and TbSb$_2$O$_4$Br are summarized in Figure 3. For TbSb$_2$O$_4$Br, in addition, a remarkably high energy transfer from Tb^{3+} to Eu^{3+} could be detected that leads to a substantially increased Eu^{3+} emission intensity, rendering it an efficient red light emitting material [2].

References

[1] F. C. Goerigk, Th. Schleid, *Z. Anorg. Allg. Chem.* **2019**, *645*, 1079–1084.
[2] F. C. Goerigk, V. Paterlini, K. V. Dorn, A.-V. Mudring, Th. Schleid, *Crystals* **2020**, *10*, 1089–1111.

Primary author: Mr GOERIGK, Felix Christian (University of Stuttgart, Pfaffenwaldring 55, D-70569 Stuttgart)

Co-authors: Prof. SCHLEID, Thomas (University of Stuttgart, Pfaffenwaldring 55, D-70569 Stuttgart); Dr PATERLINI, Veronica (Stockholm University); Prof. MUDRING, Anja-Verena (Stockholm University)

Presenter: Mr GOERIGK, Felix Christian (University of Stuttgart, Pfaffenwaldring 55, D-70569 Stuttgart)

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