Novel highly luminescent europium dinitrosalicylates.

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A series of lanthanide dinitrosalicylates $M_3Ln(3,5\text{-}NO_2\text{-}Sal)_3 \cdot nH_2O$ (Ln = Eu, Gd; M = Li, Na, K, Cs) was synthesized. It was found that the luminescence efficiency of some $M_3Eu(3,5\text{-}NO_2\text{-}Sal)_3 \cdot nH_2O$ compounds was near to the high efficiency of europium dibenzoylmethanate with 1,10-phenanthroline, $Eu(DBM)_3 \cdot Phen$. The luminescence excitation spectra, electron-vibrational luminescence spectra, and vibrational IR spectra were investigated. The energy of the lowest excited triplet state of the ligand was obtained from phosphorescence spectra of $M_3Gd(3,5\text{-}NO_2\text{-}Sal)_3 \cdot nH_2O$, $M(3,5\text{-}NO_2\text{-}HSal) \cdot nH_2O$, and $M_2(3,5\text{-}NO_2\text{-}Sal) \cdot nH_2O$. The details of the structure of compounds were discussed. The influence of different M-cations on the Eu^{3+} luminescence efficiency and on the processes of excitation energy transfer to a Eu^{3+} ion was analyzed. The presence of large alkali metal cations in lanthanide dinitrosalicylates and an increase in the temperature weaken the network of hydrogen bonds and, to some extent, the “ligand–metal” bonds. This is a cause of a long-wavelength shift of the intraligand charge transfer (ILCT) band in Eu^{3+} excitation spectra arising at inclusion of Cs^+ instead of Li^+ cations in the crystal lattice and at the heating of compounds. A change of the energies of ligand electronic states at substitution of Li^+ and Na^+ for Cs^+ can give a tenfold enhancement of the Eu^{3+} luminescence efficiency at 300 K.

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