Cation Distribution in Eu^{2+}- and/or Eu^{3+}-Containing Inorganic Compounds

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Divalent Eu^{2+} ($4f^{7}5s^{2}5p^{6}\underline{6s^{2}}$) or trivalent Eu^{3+} ($4f^{6}5s^{2}5p^{6}\underline{5d^{1}6s^{2}}$) ions exhibit extremely interesting electrical and optical properties in various inorganic compounds. The coordination of such ions in the crystal structure, for example, would be in control of the photoluminescence of materials used for cathode-ray tube, plasma display panels and imaging plate.

The site occupation of Eu ions has been mainly examined in this study. X-ray diffraction and absorption techniques were applied to such typical compounds as $YNbO_4$, Y_2O_2S, $BaMgAl_{10}O_{17}$ and Eu_3S_4, which contain Eu^{2+} and/or Eu^{3+}. Fine powder crystals of $(Y,Eu^{3+})NbO_4$ were successfully synthesized by the polymerizable complex method and used for structural analyses with the Rietveld method. Single crystals of Eu_3S_4 were synthesized from the powder sample with 0.06 g NH_4I flux by the vapor growth. The crystal structure of a mixed-valence compound, Eu_3S_4 has been examined by the valence-difference contrast method of anomalous scattering at the Eu L_{II} absorption edge. The hopping character of 4*f* electrons between adjacent Eu sites is partially frozen between Eu^{2+} and Eu^{3+} ions below T = 210 K. A charge-ordered tetragonal structure was determined below T_c = 188.5 K, where a half of Eu^{3+} ions occupy the whole 4*a* sites, while the remaining half of Eu^{3+} ions mix with all Eu^{2+} in the 8*d* sites.

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