Investigation of ionization quenching process in phosphors with 5*d*-4*f* transition by photoconductivity measurement

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Phosphors with 5d-4f transition of lanthanide ions such as Ce^{3+} and Eu^{2+} are widely used for white light emitting diode (LED) applications because of many good optical properties of high quantum efficiency, high quenching temperature and color variation. However, not all phosphors with the 5d-4f transition show efficient luminescence. In this study, the luminescent quenching by thermal ionization in Ce-doped garnet phosphors is investigated by photoconductivity measurement.

Polycrystalline Ce^{3+}(0.5%)-doped garnet ceramics, such as $Y_3Al_5O_{12}$ (YAG), $Y_3Al_2Ga_3O_{12}$(YAGG), $Y_3Ga_5O_{12}$(YGG), were synthesized by the solid-state reaction. The luminescence quenching efficiency and quenching temperatures becomes low with increasing Ga content. In addition, YGG:Ce^{3+} does not show luminescence at low temperatures. In the photoconductivity measurement, the intense PCE bands attributed to the transitions from the ground 4f level to the $5d_1$ and $5d_2$ were observed in Ce^{3+}-doped YAGG and YGG, but not in YAG. This result shows that the luminescence quenching of YAGG:Ce^{3+} and YGG:Ce^{3+} are caused by ionization processes because of the small energy gap between 5d levels and the conduction band [1].

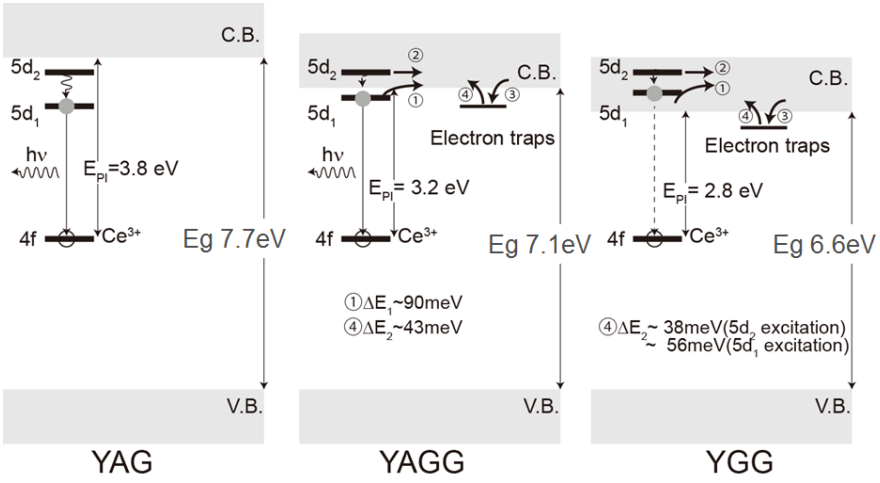

Figure 1. Energy diagram of Ce^{3+}-doped garnet phosphors

[1] J. Ueda, S. Tanabe, and T. Nakanishi, *Journal of Applied Physics* **110,** 053102 (2011).

5d-4f 発光を有する蛍光体においては、5d 準位から伝導帯の電子移動（イオン化）プロセスが消光原因ある場合が多い。その直接検出には、光伝導度測定が有効であり、光電流の波長依存性より、発光中心の励起準位からの電子移動が証明可能である。