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光激发下 $Li_6Gd(BO_3)_3$:Ce晶体发光和衰减的温度依赖特性

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摘要 研究了80~500K范围内, 光激发下$Li_6Gd(BO_3)_3$:Ce晶体发光和衰减的温度依赖特性. 在346nm光激发下, 热猝灭占优势, 发光随温度升高而降低. 在274nm光激发下, 发光由Gd^{3+}向Ce^{3+}的能量传递和热猝灭共同决定: 低于200K时, 能量传递占支配地位, 发光随温度升高而增强; 高于200K时, 热猝灭占优势, 发光随温度升高而减弱. 225K以下, 辐射跃迁占优势, 衰减随温度升高而略有增大; 225K以上, 无辐射跃迁占优势, 衰减随温度升高而减小. 利用经典的热猝灭公式和Arrhenius公式, 获取的激活能分别为0.33和0.32eV.

关键词 发光 衰减时间 Li6Gd(BO3)3:Ce 温度依赖

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Temperature Dependence of Luminescence and Decay Time under Optical Excitation from $Li_6Gd(BO_3)_3$:Ce Single Crystals

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Abstract The temperature dependence of luminescence and decay time under optical excitation from $Li_6Gd(BO_3)_3$:Ce single crystals was investigated in the temperature range of 80--500K. The Ce^{3+} emission under the direct Ce^{3+} excitation (346nm) shows the temperature dependence different from that under the Gd^{3+} excitation (274nm). The former is governed mainly by the thermal quenching effect and the later is determined collectively by the energy transfer from Gd^{3+} to Ce^{3+} and the thermal quenching of the Ce^{3+} emission. Below 200K, the luminescence intensity under the 274nm excitation is enhanced with the temperature, which is attributed to the increase of the energy transfer rate from Gd^{3+} ions to Ce^{3+} ions. Beyond 200K, the luminescence intensity under the 274nm excitation is dominated mainly by the thermal quenching effect and decreases with the temperature. Decay times at different temperatures from 80K to 500K were measured and two distinct decay changing trends were observed. The decay time increases slightly with the temperature below 225K, which is ascribed to a photon trapping effect. Beyond 225K, the decay time reduces gradually when the temperature is increased, which is caused by the increase of the non-radiative relaxation rate. The activation energy calculated by using the classical thermal quenching equation, 0.33eV matches well with that deduced by using the Arrhenius law, 0.32eV.

Key words luminescence decay time Li6Gd(BO3)3:Ce temperature dependence

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