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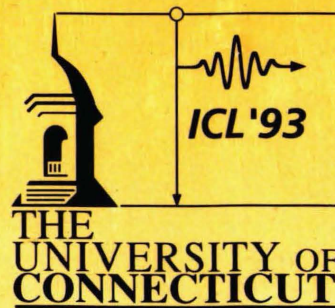
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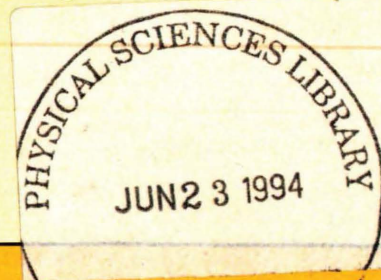
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EDITOR

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Cathodoluminescence of Ce:La₂Be₂O₅ single crystals

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Abstract

Ce³⁺:Y₃Al₅O₁₂ (Ce:YAG) is an important phosphor in high intensity CRT displays since it does not saturate at high electron beam power. The saturation power level is of the order of 1 W/cm² for most cathodoluminescent materials, and this limits the maximum surface brightness of a typical cathode ray tube. However, Ce³⁺:YAG has been found to be linear to at least 10⁴ W/cm². This performance has encouraged our examination of another cerium activated phosphor, lanthanum beryllate, Ce:La₂Be₂O₅ (Ce:BEL). A crystal of lanthanum beryllate activated with a cerium concentration of 410¹⁸ atoms/cm³ was grown by the Czochralski crystal growth technique. Wafers were prepared from the crystal and analyzed in both the as-grown state and after annealing in a flowing atmosphere of 10% by volume hydrogen in argon at 1150 °C for 4 h. Cathodoluminescent measurements revealed a broadband blue emission of 100 nm width centered at 480 nm, a blue-shifted analog of the Ce:YAG spectrum. A linear efficiency of 0.13 lm/W was found to a power loading of 8 W/cm². Pulsed excitation of a Ce:BEL crystal by 375 nm radiation produced by frequency doubling of a 750 nm laser demonstrated a decay time of the fluorescence of the order of 50 ns. All these data show that Ce:La₂Be₂O₅ is an excellent candidate as a blue phosphor for high intensity CRT applications, particularly for high resolution projection displays using single crystal faceplates.

1. Introduction

Conventional CRT faceplates are formed by the deposition of phosphor powder on the inside of a glass envelope of limited thermal conductivity. The image resolution and power capabilities of these faceplates are limited, and many applications now require CRT performance at the limits of phosphor faceplate technology. The resolution of conventional faceplates is limited by phosphor particle size to about 20 μm. Long-term operation at high intensity is limited by a decomposition threshold of about 1 W/cm². Short-term operation at high intensity is limited by saturation effects which, aside from thermal quenching and space charge build-up, arise from activator ground state depletion, excited state absorption and

cross-relaxation processes. Activator ground state depletion as a consequence of long fluorescent decay time is a general feature of phosphors [1]. Phosphor particles will actually melt at about 5 W/cm². High-intensity operation also limits phosphor lifetime by a process called coulombic degradation. This failure mode reduces the intensity of P53, a standard phosphor, to 50% of its initial value after an electron dosage of 140 C/cm². This leads to a CRT lifetime in a high luminance application of about 1000 h under the best conditions.

Single crystal cathode ray tube faceplates have several significant advantages over powder phosphor faceplates. Since single crystals have no granulation, resolution is limited only by the dimension of the electron beam. Single crystal

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