

## Hot hole excitation of $\text{EuGa}_2\text{S}_4$ electroluminescent thin films

Applied Physics Letters, Vol. 85, No. 6, 2004, pp. 923-925, August, 2004

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In order to realize a wide-scale and high-resolution display, we are exploring highly efficient phosphor materials and their excitation mechanism. Hot electrons have long been known to be dominant carriers for the excitation of the luminescent centers in high electrical field applied phosphor materials. Many theoretical analyses have assumed that the excitations are due only to hot electrons. However, there is no report to elucidate the dominant carrier type (electrons or holes) to excite the luminescent centers.

This paper describes which carrier type is dominant in pure green emitting  $\text{EuGa}_2\text{S}_4$  thin film.  $\text{EuGa}_2\text{S}_4$  is promising as an efficient phosphor material because the concentration of the luminescent centers ( $\text{Eu}^{2+}$  ions) may be 10 to 100 times higher than that of conventional materials. An asymmetric electroluminescence (EL) waveform was observed under a rectangular voltage applied to the  $\text{EuGa}_2\text{S}_4$  thin film. The EL occurs at the positively biased side of the  $\text{EuGa}_2\text{S}_4$  thin film. This indicates that the green EL occurs because of hot hole excitation. Hot electrons are known to be dominant carriers to excite the luminescent centers. Hot holes are also effective carriers for the excitation of phosphor materials.

## Influence of underlayers on the soft magnetic properties of Fe-Co-Al-O films

Journal of Magnetism and Magnetic Materials, Vol. 287, p. 387-391, 2005

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This paper describes a method to make magnetically soft films by using an underlayer on an Fe-Co-based alloy. The soft magnetic properties of Fe-Co-Al-O films deposited by sputtering  $(\text{Fe}_{70}\text{Co}_{30})_{99}(\text{Al}_2\text{O}_3)_1$  on a variety of underlayers have been investigated. A remarkable reduction in coercivity,  $H_c$ , was found in Fe-Co-Al-O films sputtered on underlayer materials, such as Au, Ag or Cu, that have a surface free energy in the region of 1-2  $\text{J}/\text{m}^2$ . All underlayers induced a bcc-(110) preferred grain orientation in the Fe-Co-Al-O films, although this effect was weak for Au, Ag and Cu. When the surface free energy of the underlayer material is higher than 2  $\text{J}/\text{m}^2$ , as in the case of Hf, Fe-Co-Al-O films can be grown with a well-defined bcc-(110) crystallographic texture. The primary effect of varying the underlayer in Fe-Co-Al-O bilayer structures is to change the crystallographic texture of the Fe-Co-Al-O films due to the difference in surface free energy. Transmission electron microscopy performed on cross-sections revealed the presence of clear columnar grains for all underlayers, with an average size of approximately 50 nm for Hf, dropping to 5-7 nm for Au, Ag and Cu. This allows us to explain qualitatively the reduction in  $H_c$  by using Hoffman's ripple theory.

## Energy-transfer and light-emission mechanism of blue phosphorescent molecules in guest-host systems

Chemical Physics Letters, Vol. 400, No. 1-3, pp. 86-89, 2004.

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We are investigating the light-emission mechanism of organic light-emitting devices (OLEDs) for full-color flexible displays. The energy transfer between phosphorescent guest and fluorescent host molecules plays a significantly important role for the determination of the emission efficiency of phosphorescent OLEDs. In this letter, we report on the energy-dissipative processes of blue-light-emitting phosphorescent molecules of bis[(4,6-difluorophenyl)-pyridinato- $\text{N},\text{C}^{2'}$ ](picolinate) iridium(III) (FIRpic) doped into two fluorescent host molecules, 4,4'-N,N'-dicarbazole-biphenyl (CBP) and 4,4'-bis(9-carbazolyl)-2,2'-dimethyl-biphenyl (CDBP). The phosphorescence spectra were measured over a wide range of temperatures from 8 K to room temperature. The triplet energy of FIRpic, CBP, and CDBP were estimated to be 2.64, 2.55 and 2.79 eV, respectively. For FIRpic in a CBP host, we observed both forward and backward energy transfer from the FIRpic triplet states to the CBP triplet states, resulting in unique temperature dependence of the phosphorescence intensity. On the other hand, the phosphorescence intensity of FIRpic in a CDBP host did not show any temperature dependence, indicating that the triplet energy is efficiently confined on the FIRpic molecules. This leads to the higher external quantum efficiency of the OLED based on FIRpic-doped CDBP. This work will be helpful in the development of new phosphorescent guest molecules and host molecules for highly efficient OLEDs.