Rare-earth Information Center Insight

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Volume 11 | February 1, 1998 | No. 2

$SrGa_2S_4:Eu^{2+}$ Phosphor for Low-voltage Displays

The amount of space taken up by computer monitors and large screen TVs is a major driving force behind the efforts to develop flat displays. Field-emission arrays are one technology, which is currently being developed. In a field-emission array, each pixel is essentially driven by its own little electron gun, which produces the electron stream through field emission rather than thermal emission, as in a CRT. The operating voltage of a field-emission display (FED) is considerably lower than a CRT, but the current is higher. In addition, unlike a CRT, where the electron beam must be rastered across the entire screen, in a FED each pixel is constantly addressed. These factors, plus the fact that the quality of the display must match the quality of the technology it hopes to replace, place stringent requirements on a FED phosphor. As the quality and lifetime must match a CRT, the chromaticity and maintenance properties must meet or exceed those of the CRT. The lower operating voltage means that there is less energy to be transferred from the exciting electron to the phosphor, yet the phosphor must exhibit high efficiency and must not saturate under the high currents in an FED. For a luminescent display, 60% of the light output comes from the green phosphor. As a result, S. Yang et al. {*Appl. Phys. Lett.*, **72**, 158-60 (1998)} have studied two potential green phosphors Gd_2O_2S:Tb and $SrGa_2S_4$:Eu. They were compared to the standard CRT green phosphor, ZnS:Cu,Al. They found the $SrGa_2S_4$:Eu produced the highest luminance for a given current density, which could result in lower power consumption and longer lifetimes. One of the more interesting aspects of the study was the contrast between the CRT requirements and the FED requirements. Since the pixel address time for an FED is ~ 30 μs compared to ~ 10ns for a CRT because the FED does not have to raster all the pixels with a single electron source, a single activator in the FED phosphor may be excited and transfer its energy ~60 times during the address time, as compared to once for a CRT. This process overcomes the fact that the FED has a lower excitation voltage; and, hence, less energy per electron.

Thermal Wave Imaging

A recent article by Z. A. Chaudhury et al. {*Mater. Lett.*, **34**, 76-80 (1998)} is of interest, both because it deals with the reliability of a new type of high temperature CO detector based on TiO_2-Y_2O_3, and because of the method used to determine the integrity of the bonding of the sensor material to an alumina substrate. By heating the surface of the sample with pulse from a high intensity xenon flash lamp, and then monitoring the spatial variation of the surface temperature as a function of time, using an infrared focal plane array as a function of time, the authors were able to evaluate bond integrity after thermal cycling,allowing them to determine the optimum concentration of a bonding agent, tetraethyl orthosilicate, which was added to the sensor material before sintering. This additive is interesting, since it tends to leave a glass layer at the interface between the sensor material and the substrate enhancing the bond.

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Calculating Valence Stability

From an experimentalist's point of view, rare earth materials were originally interesting because you could have a variety of magnetic characteristics without changing much in the crystal structure, since they were trivalent. But, of course, there were the exceptions, which made things interesting, Ce^{4+}, Pr^{4+}, Sm^{2+}, Eu^{2+}, etc. Most of these can be explained in filled shell and half-filled shell terms. In many structures, the difference between the trivalent and non-trivalent state is large enough that calculations of the energies of the 4*f* states do not have to be particularly accurate in order to predict the correct valence. As usual, nature provides us with a few challenges, in particular where it seems that she can't quite decide what the valence should be. When the energy levels are close enough together, intermediate valence compounds or heavy fermion behavior is observed. In order to calculate such behavior from first principles, the energy difference between divalent and trivalent state must be calculated with high precision. A. Delin et al. {*Phys. Rev. Lett.*, **79**, 4637-40 (1997)} have used a state-of-the-art total energy method and information on atomic excitation energies to calculate this difference to within 0.15eV for lanthanide metals and selected Sm and Tm chalcogenides. The results have been validated by comparison with experiment.

Liquid Y and Nd Precursors for MOCVD

Metalorganic chemical vapor deposition (MOCVD) has been used to produce thin films of rare earth oxides, such as high temperature superconductors. MOCVD of rare earth materials requires a volatile source of the rare earth ions. Typically, this has been a solid material such as dipivaloylmethanato (DPM) complexes, which are relatively stable in air. The problem with these solid sources is that the vaporization rate is a function of surface area; and, hence, it is difficult to tightly control compositions. Low melting point liquids offer several advantages, but these precursors frequently contain F which may be incorporated into thin films of high-temperature superconductors. Y. Tasaki et al. {*Jpn. J. Appl. Phys.*, **36**, 6871-5 (1997)} have reported new precursors, 2,2,6,6-tetramethyl-3,5-octanedionato (TMOD) Y and Nd complexes, which can be used in the liquid state to obtain stable deposition rates. They have fabricated Y_2O_3 and Nd_2O_3 thin films by MOCVD using these precursors.

Elements

Many of you are familiar with TradeTech's publication, "Elements". This report of market activity and industry news, which was previously published bimonthly, has now been combined with the "Elements Monthly Market Activity Bulletin" and will be published monthly. This month's issue contains an interesting feature article on the work on high purity rare earth alloys and compounds, which is being conducted by a scientist at the Russian Academy of Science. TradeTech may be contacted at (303) 573-3530 or tradetec@ix.netcom.com.

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