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Solar Cells

While we are familiar with the use of Eu in such materials as YVO_4:Eu, Y_2O_3:Eu and Y_2O_2S:Eu in color picture tubes, an interesting use of Eu has recently been reported by Nakata *et al.*, **Jpn. J. Appl. Phys. 35,** L90-L93(1996). One of the limiting factors for the conversion efficiency of solar cells is that they have a spectrographic sensitivity that is narrower than the spectrum of sunlight. Thus, a considerable amount of sunlight incident on the cell is not efficiently converted to electrical energy. This problem may be partially addressed by making multi-layer cells where each layer has a different spectral response but still a significant fraction of the short wave length and, hence, the high energy portion of the spectrum is not converted efficiently. It is well known that photons with energy above a given optical absorption edge for an ion can raise the ion to the excited state and then the excited state decays either directly or through a number of steps resulting in the emission of photons at lower energies (longer wave lengths). Nakata *et al.* have used CaF_2:Eu placed in front of a solar cell to use this effect to shift UV-region sunlight into the visible region and a significant enhancement of the total conversion efficiency was observed.

Infrared-to-Visible Light Conversion

While the process of converting ultraviolet to visible light is relatively simple, the shifting of infrared to visible is more complex. In this case, an ion must be excited sequentially through a number of excited states and then decay directly to the ground state. This process is of interest for applications such as upconversion lasers which emit in the blue-green region while being pumped with a diode laser. Araujo *et al.*, **Appl. Phys. Lett. 68,** [5], 602-604, (1996), report on the use of Er^{3+} doped fluoroindate glasses for infrared-to-visible continuous wave (CW) upconversion. Interestingly, the main mechanism for upconversion appears to be energy transfer among Er^{3+} ions in the excited state rather than stepwise excited state absorption of photons. What makes the Er^{3+} ions particularly attractive is the long lifetime of the excited states so that there is ample time to further excite the ion before it decays to the ground state. The lifetimes are long in the fluoroindate glasses because of the low phonon energies associated with the glass so that relaxation by non-radiative transfer of energy to the matrix is not favorable.

CeO_2, an Insulation Layer for High T_c Superconductors

One of the appealing features of high T_c superconductors is that their operating range overlaps that of semiconductors making it feasible that hybrid superconducting-semiconducting circuits can be fabricated allowing the strengths of both technologies to be realized. For the fabrication of high T_c circuits, a suitable insulation layer must be found. The requirements of this layer are rather extreme.

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Since the high T_c materials are highly anisotropic and grain boundaries in the material act as weak links for the superconducting current, it is necessary to grow high quality heteroepitaxial multilayers so that there must be a good lattice match between the insulating and superconducting material. In addition, the insulator should have a high resistivity at 77K and a small dielectric constant if the capacitive shunting is to be low enough for high frequency use. The most commonly used materials for the insulating layer are $PrBa_2Cu_3O_7$ (PBCO) and SrTiQ (STO). PBCO is limited by a relatively low resistivity at 77K and STO has a large dielectric constant. van Wick *et al.,* **Appl. Phys. Lett. 68,** 553-555 (1996) have produced multilayers using CeO_2 which has a cubic lattice with a = 5.411Å so that the CeO_2[100] is commensurate with the YBCO[110] with a relative rotation of 45°. The multilayers were produced by laser deposition. Both a high specific resistivity and a low dielectric constant were observed. In addition, the authors were able to fabricate good ramp type structures necessary for crossovers.

Catalysts

In catalysts, a common problem is the poisoning of the catalytic surface over a period of time. Zhang *et al.,* **J. Phys, Chem. 100,** 744-754 (1996), have studied the carbon dioxide reforming of methane to synthesis gas using both conventional nickel-based catalysts and Ni/La_2O_3. X-ray photoelectron spectroscopy (XPS) measurements showed that for the conventional catalysts, i.e. Ni/γ-Al_2O_3, $Ni/CaO/\gamma$-Al_2O_3 and Ni/CaO, the -C-C- species eventually block the entire Ni surface resulting in a continuous deactivation with time. For the Ni/La_2O_3 catalysts, the surface had both the -C-C- species and a large amount of oxidized carbon leaving a large fraction of the Ni surface unblocked. In these materials, the reaction rate initially increased and then remained constant. The enhanced reaction rate correlated with the formation of $La_2O_2CO_3$ on the surface.

Press Releases:

Arnold Engineering has announced the completion of their new Magnetics Technology Center. Designed for new product and process development, the center will be used by Arnold and their customers. The center will house both process and analytical equipment. For further information contact Steve Constantinides, The Arnold Engineering Company, 300 North West St. Marengo, IL 60152, TEL: (815) 568-2000.

ETREMA Products has announced that a SONAR projector designed by Lockheed Sanders for the U.S. Navy and using a TERFENOL-D active element has demonstrated a broadband response and a band-width equivalent to a similar piezo-ceramic projector which is three times larger. TERFENOL is a giant magnetostricitve material based on Tb-Fe, (Ter-Fe), which was original developed at the Naval Ordinance Laboratory, NOL. Partial substitution of the Tb by Dy, hence D, results in improved performance. ETREMA also announced the production of record sized TERFENOL-D rods in its automated production equipment. Magnetostrictive materials have potential for a large variety of mechanical actuators. For further information contact Bill Flowers, ETREMA Products, Inc., 2500 North Loop Drive, Ames IA, 50014, TEL: (515) 296-8030.

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