Rare-earth Information Center

Insight

Center for Rare Earths and Magnetics
Ames Laboratory
Institute for Physical Research and Technology
Iowa State University, Ames, Iowa 50011-3020 U.S.A.

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Blue-emitting Thin-Film Electroluminescent Devices

In order to produce a full-color flat-panel electroluminescent display, a pure blue emitting EL phosphor with high luminance is required. Recently, a number of phosphors, including SrS:Cu, $CaGa_2S_4$:Ce and $SrGa_2S_4$:Ce, have been investigated, but do not meet the luminance levels required for displays. Now, N. Miura, et al. {*Jpn. J. Appl. Phys.*, **38**, L1291-L1292 (1999)} have produced thin-film EL devices from $BaAl_2S_4$:Eu by a two target pulsed-electron-beam technique, where the composition of the film is controlled by the relative current and pulse duration of the electron beam when the targets are sequentially illuminated with a 10ms period. The as deposited structure is subsequently annealed to produce the desired compound. One target is sintered Al_2S_3, and the second sintered BaS:Eu. The devices were constructed on a glass substrate, using ZnS buffer layers. The devices produced emit the desired wavelength, filters are not required, and the luminance is twice that of the previous phosphors.

Two-color Holographic Recording

Holographic recording is believed to be capable of high storage densities, short access times and high transfer rates. The general process consists of exciting electrons from their ionic ground states into traps elsewhere in the material. This results in a change in the optical absorption properties of the material. A major problem with this process is that, in general, the process of measuring the absorption characteristics frees the electrons from their traps, and they then decay back to the ground state resulting in a destructive read. Ideally, one would read with a photon energy, which is not sufficient to free the electrons from their traps, but in a two-level system, this is thermodynamically impossible since the trap would then be the ground state. M. Lee et al. {*Appl. Phys. Lett.*, **76**, [13], 1653-5 (2000)} have recently demonstrated nonvolatile two-color holographic recording in Tb-doped $LiNbO_3$. This is possible because the system is a three-level system. In this scheme, there are two traps with differing stabilities: a shallow trap and a deep trap. The shallow trap may be depopulated by thermal energy in a relatively short time, decaying back to the ground state while the deep trap requires a photon. The excitation energy to excite an electron into the shallow trap is less than that required to excite an electron into the deep trap. In the write process, the electron is excited to the shallow trap by one photon, and then before it can decay to the ground state, it is excited into the deep trap. This changes the absorption at the photon energy required to excite into the shallow trap, but measuring this absorption does not free electrons from the shallow traps.

CeO_2 on (001) Ge

Much of life, as we currently know it, and certainly the production of this newsletter is dependent on metal-oxide-semiconductor structures that make possible most of our microelectronics. Given the number of semiconductor-oxide-metal combinations, one might ask why the vast majority of electronics is based on Si/SiO_2 junctions. The answer lies in the fact that a well defined, read almost atomically flat, interfaces between the semiconductor, and the oxide is required. Ge and SiGe alloys have attractive properties as semiconductors, but the native Ge oxides are not suitable for device applications. On the other hand, it is extremely hard to produce a non-native oxide layer on Ge without an underlying GeO_2 layer. Recently, D.P. Norton et al. {*Appl. Phys. Lett.*, **76**, [13], 1677-9 (2000)} have achieved just that, using pulsed laser deposition of CeO_2. Since the CeO_2 is much more stable than the GeO_2, the oxygen does not diffuse into the Ge layer. This is, however, only half the problem since the vacuum requirements to keep a Ge surface from oxidizing are extremely high. However, the extreme stability of the CeO_2 makes it possible to perform the deposition under a partial pressure of H_2 at elevated temperatures where the GeO_2 is not stable. The resulting interface is atomically abrupt.

Magnetic Float Polishing

An interesting method of polishing ceramic spheres, using CeO_2 and Nd-Fe-B magnets, has been developed by Oklahoma State University. The method was developed for Si_3N_4; that is the material of choice for ceramic bearings because of its high toughness. Since surface defects result in fatigue failure, surface imperfections must be minimized. Using conventional methods requires long times, high loads, and expensive diamond abrasives. The new magnetic float polishing method uses CeO_2, which is much closer in hardness to the Si_3N_4, which minimizes damage during the initial stages of polishing and high material removal rates. The process uses a magnetic fluid, presumably a commercial suspension of submicron particles in oil. The abrasive, in this case CeO_2, is added to the magnetic fluid. A non-magnetic float pushes the balls to be polished into the fluid. When an appropriate magnetic field is applied, the magnetic particles in the fluid are drawn into the field, displacing the abrasive up against the balls with a uniform low pressure. Since the pressure is low, the float can be rotated at relatively high speeds, 1000-10,000 rpm. This enhanced polishing rate gives reduced polishing times of 16-20h, which makes one wonder how long the conventional method takes {*MRS Bull.*, **25**, [4], 20-1 (2000)}.

Conferences

The Third International Conference, "Noble and Rare Metals" (NRM-2000), will be held in Donetsk-Svyatogorsk, Ukraine, September 18-22, 2000. The conference will cover a broad range of topics, including identifying and mining resources, metal recovery and processing, applications and alloys including rare earth – transition metal intermetallics. Contact: Goltsov@physics.dgtu.donetsk.ua, www.dgtu.donetsk.ua/nm.

The 8th Paul Scherrer Institut Summer School on Neutron Scattering, "Neutron Scattering in Novel Materials", will be held August 5-11, 2000 in Lyceum Alpinum, Zuoz, Switzerland will include a series of lectures on rare-earth compounds. Contact renate.bercher@psi.ch.

Company Notes:

Santoku America, Inc., having purchased Rhodia's rare earth alloy manufacturing plant in Phoenix, is closing its Chicago office and consolidating all activities in Phoenix. The new address is Santoku America, Inc., 8220 West Harrison Street, Phoenix, AZ 85043,
Telephone: 623-936-1481, Fax: 623-936-3614.

Sincerely,

R. W. McCallum
Director, CREM/RIC