

# Rare-earth Information Center **INSIGHT**

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## RERC

The Twenty-First Rare Earth Research Conference was held in Duluth, Minnesota from July 7-12. An overview of the conference will be published in the next issue of the **RIC News** but a few comments seem appropriate for the **Insight**. The Eighth Frank H. Spedding Award, sponsored by Rhone-Poulenc Industries, was presented to Gregory R. Choppin of Florida State University in the opening session of the conference. The RERC is conceived of as a broad-based research conference and talks are aimed at a more general audience than your typical scientific conference, enabling one to glimpse what is going on outside of one's own narrow field of research. Sessions on optical properties and photophysics were mixed with synthesis, environment and an industrial session.

## Heat to Light

Back in the days when gas lamps were used for sources of light, rare earth salts were used in lantern mantels in order to produce the maximum amount of light in the visible range. As with many ideas, this one has recently resurfaced only this time it is not the human eye that the light is being tailored to but rather to the optimum range for a photovoltaic cell. Thermophotovoltaic energy generation is essentially hanging a photovoltaic cell on the outside of your camp lantern to generate electricity. The efficiency of such an operation is rather low unless the spectrum of the light source is well matched to the response of the cell. V. V. Golov *et al.*, **Appl. Phys. Lett.** **69**, [2] 280-282, (1996), have discussed the thermodynamical considerations of a selective wavelength emitter for such an application. They point out that the heat to light conversion is governed by three factors. The obvious one is the quantum yield of the luminescence for the optical transition. Equally important is the coupling of the RE ions with the phonon subsystem which governs how efficiently the ions are thermally excited. Finally, the routes by which the excited ion may relax non-radioactively decrease the photon yield. While the optical transitions of RE ions are not highly sensitive to the host lattice, the phonon spectrum of the host clearly effects the efficiency with which the ions are excited. For high efficiency it is necessary to devise a thermal light source which radiates only in the spectral band the photovoltaic cell can convert.

## Ytterbium Laser

The optical transitions of RE ions are important not only to energy conversion but to fiber optics as well. Shimokozono *et al.*, **Appl. Phys. Lett.**, **68**, [16], 2177-2179 (1996), report on the preparation of an ytterbium-doped gadolinium gallium garnet (Yb:GGG) buried channel waveguide laser. They point out that this is of technological interest, because the lasing wavelength of Yb<sup>3+</sup> in a garnet host is close to the absorption center for a Pr<sup>3+</sup> ion in fluoride fiber. Thus, a Yb laser could be used as a pump laser for a Pr<sup>3+</sup>-doped fiber amplifier (PDFA). Since the whole operation is a kind of pyramid scheme, where a high power InGaAs strained quantum well laser diode pumping source excites the

Yb laser, the coupling of the components is important. The authors claim that the channel wave guide geometry is more easily coupled to fiber components than a planar waveguide laser. Conventional liquid phase epitaxy was used to prepare the Yb:GGG film on a yttrium substituted gadolinium gallium garnet (Y:GGG) substrate. The waveguides were prepared by ion beam etching. The laser which has yet to be optimized operates at room temperature.

#### ND-Fe-B Magnets with MgO Additions

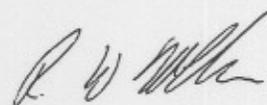
Sintered Nd-Fe-B magnets in which fine MgO powder was ball milled with the Nd-Fe-B powder, prior to sintering, are reported to have enhanced magnetic properties according to a report by Aru Yan *et al.*, *J. Alloys Compds.*, 239, (1996) 172-174. Starting from a Nd<sub>22</sub>Fe<sub>71</sub>B<sub>7</sub> composition, additions of 2 wt% MgO and 1.2 wt% Mg were studied. While MgO was added to the magnet prior to sintering, it was not present in the final magnet. Instead a new particle-like intergranular phase was observed. The incorporation of this phase resulted in a significant decrease in the volume fraction of the net-like Fe-Nd-O phase observed in the Mg free reference magnets. The coercivity was found to increase considerably with MgO additions and the reversible loss above 150°C was decreased. While improvements over the base alloy were obtained by the addition of Mg alone, the improvements did not match those of the MgO additions. The Mg additions were not as effective in producing the particle like phase as the MgO additions.

#### Decorative Hard Coatings

If you ask a ceramist about decorative hard coatings containing RE materials, they will point out that RE containing glazes have been used for decades (centuries?). The hard coatings that C. Mitterer *et al.*, *J. Alloys Compds.*, 239, 183-192 (1996) report on are a bit thinner than your average glaze. Coatings of lanthanum hexaboride (LaB<sub>6</sub>) alloyed with zirconium diboride (ZrB<sub>2</sub>) were prepared by non-reactive d.c. magnetron sputtering in an argon atmosphere. The films were applied to austenitic stainless steel and had a typical thickness of 3 to 4 μm. The purpose of the investigation was to try to improve on the high stresses and porosity accompanied by low adhesion, which are observed in most deposited films of LaB<sub>6</sub>. If these problems can be overcome, the hexaborides are candidates for coating filaments due to their low work function for thermionic emission and for decorative purposes due to their purple-red color. For the range of compositions investigated the ZrB<sub>2</sub> additions resulted in a strong tendency to form films which were partially or fully amorphous. The hardness values obtained in this manner were low and the color was silvery-gray. The poor optical and mechanical performance of the films is attributed to the low substrate temperature during sputtering, which did not allow the necessary diffusion required to obtain the expected two phase structure.

#### Business News

Meldform Metals Ltd. has acquired a majority interest in a UK based vacuum induction melting company, Less Common Metals LTD. Restructuring at Meldform has formed two limited liability companies: Meldform Rare Earths Ltd. and Meldform Germanium Ltd. For information contact Tony Bayley, Meldform Rare Earths Ltd, FAX: +44 1763 249312.



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