Rare-earth Information Center

Insight

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NdFeB 97

NdFeB 97, a conference organized by Gorham/Intertech Consulting, was held in Chicago, April 14-16. In addition to reports on the latest commercial magnet products, the conference had presentations from suppliers of rare earth materials addressing questions of availability and price. Both Rhône-Poulenc and Molycorp stressed the fact that rare earth resources are more than sufficient for the foreseeable future. The necessity of the rare earth producer finding a profitable mix of products for all elements contained in the ore was discussed in some detail. The Chinese rare earth suppliers were represented on the program by TMI International, highlighting the increasing availability of high purity materials from China. Several manufacturers (Sumitomo, Hitachi, Vacuumschmelze) discussed production magnets in the 48-50 MGOe range and laboratory samples in the 53-54MGOe range. The control of oxygen content was considered essential by all high-end producers. Corrosion resistance and coating technology was addressed by a number of talks. Applications ran the range of voice coil motors to whole body MRI magnets.

Electroluminescence from Er Doped Silicon

There is considerable interest in the production of optoelectronic integrated circuits for a variety of applications such as chip-to-chip interconnects. While erbium-doped crystalline silicon c-Si(Er) exhibits luminescence at low temperature, strong temperature quenching and long radiative, the lifetime of the Er ions make it impractical at room temperature. Recently, two different approaches have been used to fabricate light emitting diodes on a Si substrate. In the first approach, O.B. Gusev et al. {*Appl. Phys. Lett.,* **70**, [2], 240-2 (1997)} constructed a diode, where the luminescent layer was a film of erbium-doped amorphous hydrogenated Si *a*-Si:H(Er). The layer was prepared by cosputtering using the magnetron-assisted silane-decomposition (MASD) technique. The Er doping level, as determined by Rutherford backscattering, was about 10^{20} cm^{-3}. In the second approach, L. Tsybeskov et al. {*Appl. Phys. Lett.*, **70**, [14] , 1790-2, (1997)} doped porous Si with Er using electroplating followed by partial thermal oxidation at 900°C. The porous Si layer is produced on a Si wafer by anodic etching in an HF-ethanol solution. The volume concentration of Er ions incorporated in the PSi layer, based on total charge during electroplating, was 10^{19} cm^{-3}. Both LED's emitted at the characteristic Er (1.54 μm) wavelength.

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YBaCuO Microbolometers

A bolometer measures light based on the temperature increase due to absorbed light. Frequently, this takes the form of measuring the electrical resistivity of a highly temperature dependent material. For a superconducting bolometer, the superconducting sensing element is held at a temperature in the middle of its resistive transition. For high temperature superconductors, high quality films have a transition width of a few degrees or less which gives a very large temperature dependence. L. Mechin et al. {*Appl. Phys. Lett.,* **70**, [1], 123-5 (1997)} have constructed microbolometers using a suspended bridge with a $YBa_2Cu_3O_7$ film. Using oxygen implantation and subsequent heat treating, the group grew a 150-nm thick (001) oriented silicon top layer on a 400 nm thick SiO_2 layer. The top layer was patterned using standard photolithography and reactive ion etching. Since the etch rate for SiO_2 using HF is considerably higher than that of Si, it was then possible to etch the SiO_2 out from under Si microbridges. A CeO/YSZ epitaxial buffer layer was then grown on the Si and a $YBa_2Cu_3O_7$ oriented film with an 88K T_c was deposited on the top. When operated at the mid-point of the superconducting transition, the bolometers exhibited record low time constants and high sensitivity.

W - 1%La_2O_3

In order to operate with high efficiency, hydrogen energy systems require turbines which operate at 2000 K in a highly reducing atmosphere. This requires metals with high creep resistance under these conditions. The metal with the highest melting temperature is tungsten; and it is, therefore, looked at as a promising turbine material. However, at elevated temperatures, grain boundary sliding is a source of significant weakness. This problem is addressed in light bulb filaments by doping with small amounts of elements such as Al, K, or Si which cause small arrays of bubbles. The bubbles serve to pin grain boundaries and restrict grain growth at high temperature, thereby controlling grain boundary sliding. An alternate approach has been tried by M. Mabuchi et al. {*Mater. Sci. and Eng.,* **A214**, 174-6, (1996)}. In their approach, a dispersion of La_2O_3 is used to limit grain growth. The samples were produced by powder metallurgy, where W and W-0.8mass% La_2O_3 powders were pressed and sintered under hydrogen. The sintered billets were rolled into a sheet, which was annealed at 1773 K for recrystallization. While the pure W control specimen showed equiaxed grains, the La_2O_3 containing material showed grains elongated in the rolling direction. This is attributed to the manner in which the La_2O_3 particles were dispersed parallel to the rolling direction. The La_2O_3 additions resulted in significant improvements in the high temperature mechanical properties.

Bulk Amorphous Alloys with Hard Magnetic Properties

Over the past several years, a number of multicomponent alloy systems have yielded bulk amorphous alloys. That is, alloys where castings with cross-sectional dimensions in mm can be made amorphous. This is in contrast to conventional amorphous metal alloys, where rapid solidification processing produces materials with cross sections in the 10's of microns.

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