Rare-earth Information Center INSIGHT

Ames Laboratory
Institute for Physical Research and Technology
Iowa State University / Ames, Iowa 50011-3020 / U.S.A.

Volume 2 December 1, 1989 No. 12

Galfan

Galfan is a 95Zn-5Al alloy with a fractional percent of mischmetal that is used to galvanize steel. Galfan is better than conventional galvanizing alloys because of its exceptional formability, improved corrosion resistance (by a factor of two or three), and ease of painting. Because of its superior properties the amount of Galfan used has shown exceptional growth from 1600 tons in 1982 (its first year of commercial production) to 365,000 tons in 1988, with an anticipated 565,000 ton utilization in 1989. At an average of 0.05% mischmetal content, this application accounts for about 300 tons of mischmetal this year. Galfan is widely used in the appliance, automotive and construction markets. Continued research sponsored by International Lead and Zinc Research Organization will ensure continued growth of Galfan at the expense of the conventional galvanizing alloys. High levels of aluminum improve the formability and increase the corrosion resistance. However, lower aluminum concentrations (<5%) are preferred for painted surfaces, which requires a higher smoothness which is more easily attained with the lower aluminum contents.

Rare Earth Metals to Move into the Semiconductor Field!

The lowest ever contact resistivities to n-type silicon was reported by Canadian researchers using erbium in electrical contacts [P.L. Janega, J. McCaffrey and D. Landheer, **Appl. Phys. Lett. 55**, 1415 (1989)]. The rare earths are being studied because they readily form silicides (RSi_2) at low temperatures (between 200 and 450°C), which are thermally stable up to ~1000°C, resistant to oxidation up to at least 500°C, have a microhardness about the same as silicon, and less than a 2% lattice mismatch with silicon. The authors developed a three-layered structure composed of Pt/Si/Er with the Er layer in contact with the n-Si material. The material was annealed between 320 and 420°C for 10 minutes which allowed the silicon to react to form, a 280Å thick $ErSi_2$ layer in contact with the n-Si substrate, an amorphous 300Å thick 50:50 Pt-Er layer on the $ErSi_2$ and 950Å thick composite of Pt_2Si and Pt on the surface. The contact resistivity was $4\times10^{-8}\ \Omega\ cm^2$, which compares to the values of 1×10^{-6} and $5\times10^{-7}\ \Omega\ cm^2$ for the standard contacts of Al and Mg_2Si, respectively. Low contact resistances are extremely important in very large scale integration (VLSI) circuits in the microelectronics industry because when scaling down devices by a factor of K, the contact resistance increases by a factor of K^a, where $1<a<3$. One of the advantages of erbium over most of the other trivalent rare earths is

-Over-

Telephone: (515) 294-2272
Facsimile: (515) 294-3226

Telex: 269266
BITNET: RIC@ALISUVAX

its high vapor pressure, which means the rare earth layer can be evaporated at a fairly low temperature. The authors also found the $ErSi_2$ and Er adhere quite well to SiO_2 and Si during processing, and that Pt/Si/Er layered structures can be used to make good rectifying Schottky diodes.

In another recent paper M. P. Siegal et al. [J. Appl. Phys. 66, 2999 (1989)] describe the formation of epitaxial YSi_2 on (111) orientated silicon single crystals. The yttrium and silicon overlayers, which had been deposited onto the silicon crystal by electron beam evaporation in an ultra high vacuum ($\sim10^{-10}$ Torr), were annealed to form the epitaxial YSi_2 film at 300 ± 25°C. Studies revealed that epitaxial quality is as good as the best previously obtained with $NiSi_2$ and $CoSi_2$ films. They also found that the electrical resistivities were quite low. The major problem was that pinholes form in the films, just as in the $NiSi_2$ and $CoSi_2$ films. The authors believe that the pinhole problem can be solved as it was for the $CoSi_2$ films.

It appears that use of rare earths in the semiconductor industry may be an important new market for yttrium and the heavy lanthanide metals, especially erbium.

High Temperature Superconducting Applications

Japanese scientific and industrial leaders have scaled back their timetables for when the high temperature superconductors are expected to be utilized commercially. The Nikkei Research Institute of Industry and Markets now estimates that the first simple devices are about ten years away. For more advanced applications (such as supercomputers, levitated trains, electric generators, motors, magnetic resonance imaging units and power transmission cables) they are estimating that it will be about 2010. These time frames are now more or less in line with what is projected in the USA and Europe. The major problem facing everyone is how to fabricate the high T_c materials into useful forms, such as wires, ribbons and films, with good electrical, thermal and mechanical properties necessary for the various devices and applications.

Australian Terfenol

Feredyn Pacific Pty. Ltd., a Muswellbrook subsidiary, announced plans to begin the manufacture of magnetostrictive rare earth-iron rods. They claim that Feredyn will be the first to mass produce these rods.

Karl A. Gschneidner, Jr.

K. A. Gschneidner, Jr.
Editor and Director RIC