



Rare-earth Information Center **INSIGHT**

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Rare Earths Grab Share of Ribbons

A one day symposium was held in Washington, DC last year to honor individuals, teams or groups of teams who were responsible for the most significant advances in materials during the last decade. The symposium was sponsored by the National Association for Science, Technology and Society in cooperation with the Federation of Materials Societies. A total of 26 winners from the USA and other countries were honored: the sixteen gold ribbon winners discussed their contributions in oral presentations, and the ten blue ribbon winners made poster presentations. Of the sixteen gold ribbon winners, four of them involved rare earth materials: (1) the development of erbium-doped optical fibers; (2) the discovery and commercialization of the neodymium-iron-boride permanent magnets; (3) the development of an europia-doped gadolinia-yttria ceramic scintillator x-ray detector for a medical CT (computerized tomography) scanner; and (4) the high temperature ceramic perovskite-based superconductors, including $YBa_2Cu_3O_{7-x}$. Of the ten blue ribbon winners, two may involve rare earth materials, but RIC does not have any firm information concerning the use of rare earths in them at the time this issue was being written. If our hunch is correct, we will let you know in a future issue when we confirm it.

The affiliation and persons involved in the four winners are: (1) Philippe Becker of AT&T Laboratories, who represented those involved in the erbium-doped optical fiber; (2) David Claspell of Magnequench, who represented the persons involved in the neodymium-iron-boron magnet; (3) David Hoffman, Robert J. Riedner, Chuck Greskovich and D. Cusano from General Electric Corporate Research and Development, and General Electric Medical Systems; and (4) Art W. Sleight of Oregon State University, who represented those who worked in the field of high temperature superconductors. Much has been written about award winners (1), (2) and (4) over the past seven years in **RIC Insight** (and also our other publication **RIC News**), but nothing about the ceramic x-ray scintillation scanners. That oversight is corrected below.

Ceramic Scintillators

Ceramic scintillators for x-ray detectors in computerized tomography (CT) x-ray scanners were developed by a team of General Electric scientists at the Corporate Research and Development in Schenectady, New York (headed by Chuck Greskovich) and the Medical Systems in Milwaukee, Wisconsin (headed by Robert J. Riedner). These ceramic scintillators, which are called HiLight™, were developed specifically for use in a CT scanner's x-ray detector subsystem, which consists of about 1000 side-by-side ceramic scintillators arranged in an arc behind tungsten collimator plates. The scintillators are about the size of a match stick and are machined to a high precision. Behind each scintillator is a small light-sensitive photodiode, which measures the light output of the scintillator, which is proportional to the number of x-rays absorbed. The light output

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is converted by the photodiode to electrical signals which are proportional to the number of x-rays that strike the scintillator. About one million electric signals are generated in a scan and these are fed to a computer which reconstructs a cross-sectional image of the body section being examined. The ceramic scintillator is composed of a proprietary, transparent gadolinium-yttrium oxide host doped with europium oxide as the activator. The Gd_2O_3 - Y_2O_3 host has a high optical clarity in the visible wavelength region and a large x-ray absorption.

The HiLight™ ceramic x-ray detectors were evaluated in clinical tests in the mid-1980's, and the first commercial units were sold in 1988. Today about 2000 CT scanners equipped with the HiLight™ ceramic detectors are used in hospitals and clinics around the world. The radiological community found that the new x-ray detectors markedly enhanced the overall quality of the body image at a reduced x-ray dosage — a double plus for these rare earth scintillators.

Amorphous/Icosahedral Alloys

A new class of amorphous and icosahedral phases have been discovered by scientists at the Institute for Materials Research, Tohoku University, Sendai [A. Niikura *et al.*, **Jpn. J. Appl. Phys.** **33**, L1538-1541 (1994)]. These phases were observed in rapidly solidified Zn-Mg-R ternary alloys of the composition 55 at.% Zn, 40 at.% Mg and 5 at.% R. This study focused on the affect of changing R. They found that when the metallic radius is large (La, Ce, Pr and Eu) the rapidly cooled alloy is amorphous, while those alloys containing small rare earth metals (i.e. Nd, Sm, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu or Y) crystallized as a quasi-crystal with a cubic icosahedral phase. So it appears that size is an important factor for the quasi-crystal to form; however, Yb appears to be anomalous. Ytterbium's size is somewhat larger than that of lanthanum, when Yb is in the divalent state, but Yb can also be trivalent and if it is, then Yb fits the pattern established by the trivalent lanthanides and yttrium. Ytterbium might also fit as a divalent metal if there is also an electron concentration effect governing the formation of these quasi-crystals. Magnetic susceptibility measurements might be helpful in deciding on the valence, and thus size, of the Yb atom in these Zn-Mg-Yb alloys. This measurement had not been done, or at least had not been reported, by the authors.

Ce Improves Ni_3Al

The intermetallic compound Ni_3Al is being extensively studied as a high temperature refractory material, but its low ductility and brittleness are major problems which are holding back its development and utilization. The affect of small cerium additions to Ni_3Al has been investigated by Chinese scientists from Wuhan Iron and Steel University, Wuhan, Hubei and the University of Science and Technology Beijing [Y. Zhexi *et al.*, **J. Mater. Sci. Lett.** **13**, 1717-1719 (1994)]. They found that the grain boundary cohesion of specimens heat treated at low and high temperatures (550 and 1200°C) was enhanced and the ductility was considerably improved, but at intermediate annealing temperatures, 750 and 1000°C, no improvement was noted. Furthermore, they recommend that the Ce concentration should be less than or equal to 0.011 wt.%, since larger amounts of Ce could increase the brittleness of this intermetallic compound.

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