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Aerogel Auto Exhaust Catalysts!

Scientists at Ecole Centrale de Lyon [C. Hoang-Van et al., **J. Non-Cryst. Solids, 145**, 250 (1992)] have prepared a number of alumina-based aerogel supported Pd catalysts which show high conversion efficiencies for CO oxidation in the temperature range of 150 to 500°C and for NO reduction at temperatures less than 270°C. Several of the alumina-based aerogels contained CeO_2 or La_2O_3 in their formulations. The Pd/CeO_2-Al_2O_3 was particularly effective in CO conversion to CO_2 at low temperatures, reaching 100% conversion at ~230°C which compares to a conventional three-way catalyst (1%Pt-0.2%Rh/Al_2O_3) reaching 100% conversion at ~320°C. However, the maximum NO conversion was significantly lower than the standard three-way catalyst.

Aerogels are highly porous, high surface area (100 to 1000m^2 per g) solids which have been given considerable attention in recent years. The alumina-based aerogels were made by supercritical drying of alcogels obtained by hydrolysis of organic derivatives of Al, Ce and La. The alumina alcogel was prepared from aluminum sec-butoxide dissolved in sec-butanol by hydrolysis. This alcogel was dried in an autoclave under supercritical conditions with respect to sec-butanol to yield the alumina aerogel. The CeO_2 aerogel was prepared in the same manner using a Ce acetylacetonate dissolved in methanol. The binary aerogels were prepared by a co-hydrolyzing the above mentioned Al and Ce compounds dissolved in methanol. The Pd catalysts were prepared by impregnating the aerogel supports with a solution of Pd acetylacetonate or $PdCl_2$ dissolved in methanol. Although the initial tests are quite promising for practical applications, such as automobile emission control, the authors noted that further research is necessary to optimize the properties of these aerogel-based catalysts under real conditions.

Improved Er^{3+} Upconversion Phosphor

A great deal of attention is being focused on lanthanide-ion-doped materials for converting IR to visible light. Among these Er^{3+}-doped upconversion materials radiate visible fluorescence under 1.5μm, 0.98μm and 0.8μm light excitation. These phosphors offer the possibility of being used in devices visualizing 1.5μm light in optical fiber communication systems. Unfortunately, most Er^{3+} doped materials, such as oxides, sulfides, fluorides and oxyhalides have low conversion efficiencies, although YF_3-ErF_3, the most efficient upconversion phosphor, is used commercially. Recently J. Ohwaki and Y. Wang [**Jap. J. Appl. Phys., 31**, L1481 (1992)] have found that 20YCl_3-20$ErCl_3$-35$PbCl_2$-25KCl (all in mol%) phosphor to be much more efficient than the fluoride system. Under a 1.52μm laser diode excitation the Er^{3+} chloride phosphor emitted a bright green luminescence, and the intensities of the fluorescence lines at 410, 550 and 660

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nm were found to be 48, 20 and 9 times, respectively, greater than those of the conventional Er^{3+}-doped, fluoride. It is reasonable to expect the (Y-Er-Pb-K)Cl system to replace the YF_3-ErF_3 phosphor, however, considerable work remains to optimize the matrix composition, the Er^{3+}-dopant levels and the preparation conditions.

ScRu a New High Temperature Intermetallic

As part of an on-going research for better and improved alloys for use in aircraft engines operating at high temperatures, R. L. Fleischer, General Electric Research and Development Center, Schenectady, New York, has found that ScRu and AlRu doped with Y hold considerable promise as the next generation high temperature materials for aircraft engines [**Platinum Metals Rev., 36**, 138 (1992)]. The two alloys possess considerable toughness at room temperature, surprisingly so for an intermetallic compound, which are notoriously brittle. This is believed to be due to the crystal structure of these two alloys, which have the body-centered cubic CsCl structure. Furthermore, oxidation tests of uncoated AlRu and $Al_{0.48}Ru_{0.51}Y_{0.01}$ show that they could be used at temperatures up to 1250°C. Since Sc is so expensive, Fleischer added Sc as a replacement for Al in the based AlRu compound to see if there were any improvements in the high temperature properties -- and there were. Two alloys, $Al_{0.44}Ru_{0.52}Sc_{0.04}$ + 0.5%B and $Al_{0.43}Ru_{0.52}Sc_{0.05}$, had high temperature microhardnesses which were 30 to 50% higher than the unalloyed AlRu compound at temperatures ranging from 600 to 1200°C. The potential is there for the Ru-base alloys, but the question is, will these materials have sufficiently improved properties over the materials in use today, that it justifies their much higher costs? Time will tell.

Antireflection Coatings

The sensitivity and efficiency of semiconducting photoelectric devises are greatly reduced by reflected light from the surface of the semiconductor. Yu. A. Anoshin et al. [**Pis'ma Zh. Tekh. Fiz., 18**, 54 (1992); Engl. transl. **Sov. Tech. Phys. Lett., 18**, 321 (1992)] suggested and proved that a thin layer of rare earth oxides (750Å thick) would be an effective antireflection coating. The film was formed by evaporating a rare earth metal (Gd, Dy, Yb or Y) onto a Si surface in a vacuum of 10^{-5} torr, and then oxidizing the metal coating by heating in air at 500°C. The transparency of the oxide layer ranged from 85 to 98% depending upon the oxide and the wavelength, which varied from 400 to 1100nm. The reflection of light from the Si surface coated with the oxide was 0.01 to 0.07% at 600nm, the optimum wavelength of light for solar cells. The percent of reflected light from an uncoated Si surface was about 35%. Dy_2O_3 oxide coating was found to work best. The use of the Dy_2O_3 antireflection coating on Si increased the photocurrent generated by a light source operating at 600 nm by 60% over the uncoated Si. Perhaps, when photovoltaic generation of electricity is fairly common in the next century the rare earth oxides will play an important role in delivering this environmentally clean source of electricity.

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