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Humidity Sensor

As technology becomes more and more automated, sensors play an increasingly important role for the continued advancement and progress in measuring, and ultimately, controlling the amount of a chemical ion or compound present in a sample or in the environment. Humidity or the presence of gaseous water [$H_2O(g)$] in the surrounding atmosphere is an important parameter in many industrial and agricultural processes, and of course, in our personal comfort level in the work place, in the home, and in transportation — cars, buses, trains and airplanes. Most humidity sensors utilize porous ceramic materials.

Humidity measurement using ceramic materials is based on the change in electrical resistivity or capacitance due to water vapor absorption and/or capillary condensation in the pores of the sensing element. One problem is the extremely high resistivity as the $H_2O(g)$ concentration becomes low. Another problem is the affect of the water-soluble gas (CO_2, SO_2, HCl etc.) concentration on the sensitivity of the sensor. One of the best classes of materials for humidity sensors are the ABO_3 perovskite-type oxides, where A is an alkaline-earth element and B is a transition metal ion, such as titanium. The behavior of these materials can be improved by the partial substitution of a rare earth ion for the A element. One of the better known materials is $(Ba_{1-x}La_x)TiO_3$ where $x \approx 0.003$. These materials, which are n-type semiconductors, can be operated at temperatures well above 100°C which are required for drying machines and combustion-controlling systems. Recently H. K. Ardakani and co-workers from the Centre for Advance Studies in Materials Science and Solid State Physics, University of Poona, Pune, India have described a process for preparing thin films of $(La_{0.003}Ba_{0.997})TiO_3$ deposited by a laser ablation technique [**J. Mater. Sci. Lett. 12**, 63 (1993)]. Thin film sensors have certain advantages over bulk forms, because with recent advances in film growing techniques, one can have close control over the film properties, and because of their intrinsically large surface to volume ratio. The authors initially prepared a pellet of the desired composition and used it as the target material for laser ablation. This pellet had a resistivity of 508 ohm-cm at room temperature, a positive temperature coefficient of resistivity and a Curie temperature of 120°C. They found that only the films deposited on quartz substrates were sensitive to $H_2O(g)$, while those deposited on glass, alumina, p-type silicon were not particularly sensitive to the relative humidity. The electrical resistivity of the $(Ba_{0.997}La_{0.003})TiO_3$ film was quite sensitive to the relative humidity — a change of about five orders of magnitude in the resistance for a change in the humidity from 10 to 90%. Furthermore, the resistivity response to the humidity was essentially independent of the layer thickness between 100 and 800 nm, which indicates that the sensing action is essentially a surface-layer phenomena.

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CVD for ZBLAN

Hieroglyphics? Hardly! The letters CVD stand for "chemical vapor deposition" and ZBLAN for "zirconium-barium-lanthanum-aluminum-sodium" fluoride glass. ZBLAN is one of the most promising materials for making ultra-low loss optical fibers (see **RIC Insight 5,** [9] September 1992, **4** [10 and 11], October and November 1991, and **1** [3] May 1988). One of the major problems is to make the fluoride glass pure enough so that the optical losses are close to the theoretical minimum. At the present time most materials have losses about two orders of magnitude higher than this minimum due to absorption by transition and lanthanide metal ions and OH ions. Recently, Y. Nishida et al. from the NTT Opto-Electronic Laboratories, Tokai, Ibaraki, Japan proposed that one might be able to eliminate or greatly reduce these impurity ions in ZBLAN by a chemical vapor deposition process which uses the thermal reaction between metal β-diketonates and hydrogen fluoride [**Jap. J. Appl. Phys. 31**, Part 2, L1692 (1992)]. The main difficulty was to find a sodium chelate source which could be used in the CVD process. Another problem was the difficulty in controlling the glass composition. The sodium chelate which was found to work was 1,1,1,2,2-pentafluoro-3,5-heptanedione, [Na(ppm)]. Na(ppm) has a low vaporization temperature, > 180˚C, and is thermally stable up to 300˚C. The composition of the ZBLAN fluoride glass was controlled by changing the argon carrier gas flow rate and the vaporization temperature for each starting material. The thermal properties of the CVD produced material was nearly the same as those of the conventional melt-cast glass. The authors believe that this process has the potential to make long, ultra-low loss fluoride optical fibers.

Ferro Corp.

Ferro Corp., a multinational producer of specialty coatings, colors, ceramics, polishing compounds etc., which has headquarters in Cleveland, has acquired Cercoa Inc., Lake Park, Florida. Cercoa is a manufacturer of glass and plastic polishing products. With this acquisition, Ferro Corp. has increased its market share of polishing products.

At the March meeting of the Ceramic Manufacturers Association in Charlotte, North Carolina, Ferro Corp. received **Ceramic Industry's** 1992 Supplier of the Year Award for its superior service and contribution to ceramic manufacturing — Congratulations.

Dispersion Strength Alloy Tabbed for Turbine Blades

A new 1.6 MW stationary gas turbine engine, which is manufactured by European Gas Turbines Ltd., Lincoln, England, features a first stage turbine blade made of a mechanically alloyed, oxide-dispersion-strengthened nickel-base superalloy, MA 6000. This alloy, which contains (in wt.%) 69Ni, 15Cr, 4.5Al, 4W, 2.5Ti, 2Mo, 2Ta, 0.5C, 0.15Zr, 0.01B, and 1.1Y_2O_3, has excellent creep strength at 1150˚. This creep resistance is due to the ultrafine dispersion of Y_2O_3 in the alloy. According to Inco Alloys Ltd., Hereford, England, this is the first time a mechanically alloyed material has been used for a rotating gas turbine part. In addition, the blades are coated with NiCoCrAlY, which prevents or reduces oxidation of the parts. The design life of the turbine blade is 25,000 operating hours. This engine is expected to be used in combined heat and power applications by textile mills, breweries, bakeries, hospitals, universities, etc.

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