

1990

*Spring
Meetings*

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**April 16-21,
1990**

MRS

**MATERIALS
RESEARCH
SOCIETY**

**San Francisco,
California**

**FINAL
PROGRAM
AND
ABSTRACTS**

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Welcome to the Materials Research Society's 1990 SPRING MEETING

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Welcome to San Francisco and the 1990 Spring Meeting of the Materials Research Society. With 25 symposia, nearly 2000 papers, and a very broad range of topics, this is by far the largest Spring Meeting sponsored by our Society. Our "home" for this week is the newly constructed San Francisco Marriott Hotel; located just a few minutes walk from Union Square, this area offers some of the finest dining and shopping in the city—enjoy!

You may want to scan the list of symposia for items of interest. Besides such familiar topics as "Better Ceramics Through Chemistry," "Advanced Metallizations in Microelectronics," and "Amorphous Silicon Technology," you can also find "Materials Issues in Art and Archeology," "Materials for Sensors and Separations," "Alloy Phase Stability and Design," "Ferroelectric Thin Films," "Materials Interactions Relevant to the Pulp, Paper and Wood Industries," and many others. Our plenary speaker is Mark D. Zoback, Professor of Geophysics at Stanford University, who will address the Society Wednesday evening concerning a topic of substantial local interest—the October 17th earthquake. In addition, a number of interesting overview papers will be given in Symposium X, the Society's traditional lunchtime fare. You may also want to look over the MRS Short Course Program, which still has some openings available.

The Equipment Exhibit will be held in the Golden Gate Exhibit Hall beginning at noon Tuesday through mid-afternoon Thursday. Complimentary coffee will be available in the Equipment Exhibit during session breaks; we encourage your visits. There will also be refreshments during the major poster sessions on Tuesday and Thursday evenings.

Finally, we want to thank the symposium organizers for assembling an excellent program, the staffs at MRS Headquarters and The Complete Conference for tending to the innumerable administrative and logistical details associated with a conference of this size, the MRS officers, Program Committee, Publicity Committee, short course manager, and others who have given their time and effort on the Society's behalf. We welcome you to San Francisco, solicit your thoughts and comments, and wish you a stimulating, productive, and enjoyable week.

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described, but not with a great success. Now a new method has been developed.

Using cheap source materials for a sol-gel-like process, as acetates and nitrates, this method could be interesting for varistor producers. The solution of H_3BO_3 and the acetates of Zn, Co and Mn in H_2O , and a second one with $Sb(CH_3COOH)_3$ and the nitrates of Bi, Cr and Al in ethyleneglycol were stirred together. Precipitating $Sb(CH_3COOH)_3$ and zinc acetate form a gel containing all dopants. Freeze drying and calcination at $450^\circ C$ leads to a precursor, that can be used like conventional varistor powder (plastifying, pressing). Sintering will be done at $1100^\circ C$, this means about 100K less than in usual production.

Powders processed by this way guarantee better nonlinear varistor behavior of doped zinc oxide ceramics. Because of the homogenous distribution of the dopants now another addition of a donor, like Al, is necessary to obtain a steep potential wall at the grain boundary. Its positive influence on the barriers results in almost all grainboundaries being in the varistoractive state. Therefore varistors can be made smaller and more reproducible in their electric properties. The result is a lower leakage current, a better nonlinear behaviour and also a better conductivity at high current values, because the cross-section of the possible paths for the current through the microstructure of the ZnO-ceramic is increased remarkably.

A5.43

MICROSTRUCTURAL EVOLUTION OF SOL-GEL THIN FILMS. Joseph L. Keddie and Emmanuel P. Giannelis, Department of Materials Science and Engineering, Cornell University, Ithaca, NY 14853.

Electronic, dielectric and optical properties depend on the microstructure of a material. Thus, an understanding of the microstructural evolution and its control is essential not only from a fundamental standpoint but also to the commercial application of sol-gel thin films.

We have implemented a diagnostic technique to quantitatively determine the packing and mass density of sol-gel deposited films. The projected density is determined through a combination of Rutherford Backscattering and Forward Recoil Spectroscopy and then converted to density by considering the thickness of the film, as measured by ellipsometry. The results are rationalized in terms of packing of fractal reactive species.

A5.44

ELECTRON DIFFRACTION ANALYSIS OF THE STRUCTURE OF SiO_2 GEL-FILM. Hisashi Ohsaki and Michel A. Aegerter - Instituto de Física e Química de São Carlos, Universidade de São Paulo, São Carlos, SP, Brazil; Takaki Shichiri, Osaka City University, Sumiyoshi-ku, Osaka, Japan.

The structure of SiO_2 gel-film prepared from acid TEOS sol-solution was analyzed by electron diffraction method. The samples were prepared by the following procedure. A #100 mesh Cu grid with 0.24 mm diameter hole size was immersed into the sol and withdrawn vertically. Thin films of sol were self-supported in the holes of the grid by the surface tension, and were dried in warm air. The thickness of the gel films depends on the temperature of the warm air. The bulk density of the film was calculated from the slope of the internal part of the differential radial distribution function (RDF) of the film and found about 0.92 g/cm^3 . The Si-O bond length of the gel-film is about $1.58 \text{ \AA}$;

it is smaller than that of bulk vitreous SiO_2 ($1.61 \text{ \AA}$) but similar to that of $80 \text{ \AA}$ thick evaporated $a-SiO_2$.

Research supported by CNPq, FINEP and FAPESP (Brazil).

A5.45

TEM INVESTIGATION OF SOL-GEL COATINGS. L. Weisenbach, I. Klein, and B. D. Fabes, Department of Materials Science Engineering, University of Arizona, Tucson AZ.

Alkoxide-derived silica and silica-titania coatings were deposited on silicon substrates by dip coating and spin coating. Inhomogeneities in composition and morphology observed using high resolution TEM. AEM was used to determine the compositional variations in the titania-containing coatings. The evolution of the structure of the coating with firing was also observed. Contrast differences were observed at the coating/thermal oxide interface. The origin of this contrast remains unknown. Possible explanations for this contrast are discussed. The effects of spin vs. dip coating on inhomogeneities are discussed.

A5.46

PROPERTIES OF FILMS PREPARED FROM LOW SURFACE AREA/DENSITY ALUMINA-SILICATE. S.L. Hietala, D.M. Smith UNM/NSF CENTER FOR MICRO-ENGINEERED CERAMICS, Albuquerque, NM, V.M. Hietala, G. Frye, C.J. Brinker, Sandia National Laboratories, Albuquerque NM 87185

Previously, a particular range of composition and processing conditions was discovered in the silica-alum system that results in bulk materials which have anomalously low surface area. Subsequent work indicates that the low surface area is the result of closed porosity. The property of closed porosity obtainable at low processing temperature and stable over a wide temperature range is potentially attractive for applications such as low dielectric constant films and barrier coatings. In this work, films were prepared by spin-coating on both solid and porous substrates. Surface Acoustic Wave (SAW) measurements of nitrogen adsorbed at 77 K were used to find the coating surface area and pore size distribution. Under certain conditions the film surface area was equal to that of a completely dense film ($1 \text{ cm}^2/\text{cm}^2$). Helium permeation measurements at 298 K and ambient pressure were used to assess the utility of this material as a hermetic seal. Permeabilities were at least two orders of magnitude smaller than the porous Vycor substrate. Dielectric properties were derived from capacitance measurements

A5.47

THIN ANISOTROPIC COATINGS BASED ON SOL-GEL TECHNOLOGY. S. Randall Holmes-Farley and Lynn C. Yanyo, Lord Corporation, P. O. Box 8225, Cary, NC 27512.

Using sol-gel technology, thin organic/ceramic (ceramer) coatings have been applied to metal surfaces in order to enhance such surface properties as adhesion promotion and corrosion prevention. Isotropic coatings have been found to be effective in certain applications such as corrosion prevention, but the formation of anisotropic coatings permits greater flexibility over the resulting properties. Isotropic coatings derived from

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