In Memoriam

The Editor dedicates this publication to the late Professor Dr. Jerzy Zarzycki, (Lwow, Poland March 29, 1926 , † Montpellier, France, March 12, 2007).

Professor Zarzycki, of the University of Montpellier (France), was one of the pioneer scientists who identified the promising future for sol–gel processing, more than thirty years ago, and made numerous contributions of great impact to its foundation and development, until his retirement.

Photograph taken during an interview with H. Arribart, B. Bensaude, and A. Hessenbruch August 10th 2001 for the History of Recent Science & Technology (Copyright: The Dibner Institute).

Thirty years of new materials from gels

Much has changed in the Sol-Gel field since this technique appeared as a breakthrough in materials science in the late 1960's. It is not commonly known that the first applied research on sol-processes occurred in the field of nuclear ceramics. Only when development work on fuel microspheres slowed down did the pioneers of "sol-gel processing" claim that the technique was particularly suitable for the synthesis of complicated multicomponent glasses, because the liquid state favors homogeneous mixing at temperatures much lower than the fusion point. Until then, glass production had been defined as a process that involved cooling from the melt. However, sol-gel processing of thin dielectric coatings became the only well-established application for sol-gel processing. The situation has evolved rapidly since then. In the mid-1980's, if asked about future trends in sol-gel processing, not many scientists would have foreseen the kinds of research that are now being carried out in most sol-gel laboratories. The early emphasis was on the chemical synthesis of materials at room temperature or slightly elevated temperatures, and on homogeneous multicomponent products of highly controlled purity. Today, work on gel → glass conversion has ceased almost completely. Basic research done up to then had resolved and explained the majority of the chemical and physical phenomena of sol-gel processing; and the foundations had been laid for a number of present and future applications.

Regarding the possibilities for sol-gel methods in synthesizing a large number of pre-forms, aerogels occupy a privileged position; they are interesting products in themselves because of their very particular structure that, in some cases, can be described in terms of fractal geometry but, above all, important new applications are being found. Another promising sol-gel processing approach is the homogeneous combination of organic and inorganic precursors to form a hybrid structure. This opens up a huge number of possibilities in the field of organic-inorganic hybrid materials (OIHM).

I have included in this book a number of contributions on the more recent applications of Sol-Gel science. Ceramics and films from gels are among the first applications developed by the early sol-gel researchers. The possibility of tailoring structure and controlling particle growth has enabled more advanced materials to be obtained. Several other potential applications were foreseen fifteen or twenty year ago but their realization only became possible after research on precursors had enabled progress towards the preparation of new pre-forms. At that time, my teacher, Professor J. Zarzycki" (†2007), to whom I dedicate this compilation, claimed: "The future of the sol-gel process is in the hands of chemists". Researchers then began to move on from the "old" problem of how to eliminate undesirable porosity, to the new challenge of taking advantage of the fine structure of gels, with the object of using them as a filter in the nm range or of incorporating an active second phase. This new era in sol-gel processing was opened by three applications presented at the conference on sol-gel optics in 1994 [1]. The first example was presented by D. Levy et al. from Spain concerning liquid crystal display. The second was an optical fibre sensor developed by B.D. MacCraith from Ireland. The third corresponded to a biological parasite detector developed by J. Livage et al. from France. Currently, the rheological properties of sols and gels are leading to uses in the preparation of bulk product, films, membranes, fibers and composites. As a result, biomaterials, catalysts, optically-active composites and membranes can now be prepared from gels.

[1] *Sol-Gel Optics-III, SPIE Proc.*, Ed. by J.D. Mackenzie, San Diego, CA, (1994) vol. 2288

Work on the fluid properties of the sol has even widened the field of application to the restoration of monumental stonework – an interesting contribution of materials science to culture.

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Luis Esquivias

Editor

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Cover by Antonio Esquivias.