Editorial

Sol-Gel: Past to Present

I would like to present a brief overview of the history and current state of sol-gel science and technology for this inaugural issue of the **Journal of Sol-Gel Science and Technology.**

In my view, the present state of the sol-gel field can be traced back to 1970, although work before 1970 cannot be neglected. In 1970, Dr. H. Dislich of Schott made a pyrex-type glass at a temperature of 620°C by hot-pressing a gel powder. Dr. K.S. Mazdiyasni's group made well-sintered dense ferroelectric ceramics by heating sol-gel powder compacts at relatively low temperatures. Prof. R. Roy of Pennsylvania State University showed that a small silica glass piece can be prepared by heating silica get at about 1000°C. The reaction to these pioneering works was slow. A paper by S. Sakka's group was the only one of its kind presented at the Tenth International Congress on Glass in 1974.

By the end of 1970s, however, many research groups tried to apply the sol-gel method to preparation of large-size silica monoliths for silica glass preforms to be used in optical communication fibers. This coincided with efforts to develop the optical communication systems using silica-based fibers. I should mention an important event: the late Prof. V. Gottardi's establishment in 1981 of the International Workshop on Glasses and Glass-Ceramics from Gels. No mention is needed of the important role this international workshop series played in promoting sol-gel research and enlarging the sol-gel world.

A remarkable development in the sol-gel arena took place in the mid-1980s when Prof. H. Schmidt developed sol-gel preparation of organic-inorganic composite materials in which organic polymers connect inorganic constituents. This development attracted not only inorganic material scientists, but also polymer and organic chemists to sol-gel science and technology. The division between inorganics and organics was removed. This also broadened the variety of materials available for high technologies thanks to further lowering of the sol-gel process, nearly to room temperature, where organic molecules are retained without decomposition.

In these years, the importance of materials was strongly indicated by demand for high-performance materials in such high technologies, as communications, information processing, electronics, photonics, chemistry, catalysts, biomedical science, and environmental technology. One of the most remarkable examples is nonlinear optical materials, which are regarded as a prerequisite to future photonic devices. Since the sol-gel method is quite suitable for preparing thin films, many kinds of nonlinear optical materials have been attempted in the form of film.

Needless to say, the above-mentioned development has been accompanied by basic research on sol-gel processing: hydrolysis-condensation reactions of the compounds in solution, sol-gel transformation, vitrification, crystallization of gels on heating, etc.

This work has continued to the present, resulting in the sol-gel science and technology of today.

The primary objective of sol-gel research is to produce materials with optical, electronic, chemical, mechanical, and thermal activities. Therefore, it is appropriate to cite sol-gel based industrial products on the market thus far. These are (1) heat resistant fibers of silica, alumina, silica-alumina, and related compositions, (2) strong alumina-based abrasive grains, (3) highly active starting powders for dense mullite and cordierite ceramics, (4) alumina powders with highly selective grain sizes, (5) green alumina sheets for IC substrates, (6) machinable mica ceramics, (7) titania flakes, (8) reflecting coating for windows used for controlling solar lights, (9) reflecting silica-titania coating of automobile windshields for head up display, (10) antireflecting coating films on large-size sheet glasses for clear sight, (11) silica based coating films containing organic pigments on the face plates of televisions—for high resolution color pictures, (12) chemically protective and water-repellent coatings of steel plates, (13) silica-based powders for medical care of skin, and (14) submicron and micron-size silica particles as spacers for liquid crystal display panels. It should be noted, however, that these are only the examples I am aware of.

Briefly, sol-gel science and technology has experienced enormous development in these 20 years, but there is still great potential for growth.

Finally, I hope the **Journal of Sol-Gel Science and Technology** will serve as an indispensable international forum for further promoting sol-gel science and technology and exploiting the bright future of the sol-gel field.

Sumio Sakka
Editor-in-Chief