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29. Motowo Takayanagi

Otto Vogl

University of Massachusetts - Amherst, vogl@polysci.umass.edu

Tisoro Kajiyama

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Personalities in Polymer Science



Motowo Takayanagi

Honoring Professor Takayanagi on his 77th Birthday* [Kijyu]

Motowo Takayanagi has been a pioneer in polymer physics. He was responsible for the development of the understanding of viscoelastomers and he established the concepts of the physical and viscoelastic properties-structure relationship of polymeric solids, of crystalline polymers and of polymer blends.

Motowo Takayanagi was born in Kokura which is now part of Kitakyushu, Japan on December 11, 1920 as the son of Yoshiro Takayanagi and Sadako. His father was an Electrical Engineer, and a graduate of Kyoto Imperial University. Sadako's uncle, Chiaki Watanabe was the Minister of the Imperial Household. Motowo Takayanagi also has two sisters. His younger sister became a professional artist in embroidery.

Motowo Takayanagi went to Sakaimachi Elementary school in Kokura from 1927 to 1933 where he became known for his interest in Calligraphy. He then went to the Kokura Middle School in Kitakyushu from 1933 to 1937 where he became interested in science by drawing flowers and animals. From 1937 to 1939 Motowo Takayanagi attended Fukuoka High School.

In 1939 Motowo Takayanagi enrolled in the Department of Applied Chemistry, Kyushu Imperial University in Fukuoka and graduated in 1942 under the guidance of Professors Toshio Okuno and Wataru Sakai with the thesis entitled "The Mechanisms of Electrolysis of Molten Salts on Alumina". He was appointed to the chair of Professor Sutezo Kuriyama as a Assistant Professor (*ko-shi*) at the same University and was promoted to Associate Professor (*jo-kyoju*) in 1944. After the war Kyushu Imperial University was renamed Kyushu University. In 1945 Motowo contracted a serious illness and was unable to work until 1952.

Subsequently, Motowo Takayanagi started to work on his doctoral degree with Professor Kuriyama and received his degree of Doctor of Engineering in Polymer Chemistry from Kyushu University in 1960 with a thesis entitled "Crystallization Kinetics of Polyesters". In the same year Motowo Takayanagi was appointed Full Professor (*kyoju*) of Applied Chemistry at Kyushu University. He was active at Kyushu University until his mandatory retirement in 1984 and is now Professor Emeritus of Kyushu University. Subsequently, Takayanagi accepted a position as Professor of Chemical Industry in Kyushu Sangyo University and was active there from 1984 to 1994.

Motowo Takayanagi was always a very popular teacher and lecturer and was invited as Visiting Professor to a number of institutions. He was a Guest Professor at Kagoshima University 1966-1967, Osaka University (1972), Nagasaki University (1973), Saga University (1973-1983), Miyazaki University (1976), Nagoya University (1979), Hokkaido University (1980) and lectured at Tokyo and Kyoto University. He was at the Midland Macromolecular Institute, USA in 1974, at Leeds University, England in 1984 and the Changchun Institute of Applied Chemistry, Chinese Academy of Sciences in 1984.

Motowo Takayanagi made significant scientific contributions to a number of areas of polymer science: crystallization kinetics, morphology of polymer single crystals, polymer alloys and solid state extrudates and especially the structure-physical and mechanical property

relationships of polymeric materials. Takayanagi has made significant contributions to measurements and descriptions of viscoelastomers, using the "Rheovibron" which he had invented in 1959. The Rheovibron was a unique pioneering instrument, which has played a dominating role in what is now called Dynamic Mechanical Analysis. Takayanagi also contributed to the analysis of the crystalline relaxation (the α , dispersion and absorption) based on dynamic viscoelastic, X-ray, ESR, IR and ultrasonic wave studies and observations by transmission electron microscopy.

Takayanagi also was the first to measure the viscoelastic characteristics of polymer single crystal mats. He concluded that the crystalline relaxation is attributed to an initiation of viscoelasticity in a crystalline phase. Based on his novel concept of the crystalline relaxation, he proposed that the most appropriate temperature for cold processing of crystalline polymeric solids is the α temperature, a technology which is now recognized as "Crystalline Relaxation Drawing". Motowo Takayanagi is also known for the *Takayanagi Model* which is applied to two-phase polymer systems, and predicts the viscoelastic properties of such systems.

Motowo Takayanagi was also in the forefront of research of molecular composites where the components were miscible on a molecular level. He used systems where the reinforcing fibers in the composites were rigid polymers and proposed a novel concept of the molecular-reinforcing mechanism. The advantage of molecular composites are (1) large aspect ratio of a rigid rodlike polymer (2) availability of ideal strength of covalent bonds in a main chain and (3) a molecular homogeneous mixture.

Takayanagi's research accomplishments are published in about 520 papers and reviews and he edited 3 books. He was/is on the Editorial Boards of 10 prestigious polymer related Journals.

Takayanagi received many awards for his remarkable accomplishments in polymer physics. The Chemical Society, Japan Award in 1969, the Distinguished Educator Award of the Society of Plastics Engineers in 1978, the Award for Dis-

*For the significance of special Japanese Birthdays, see also O. Vogl and T. Ouchi, *Polymer News*, 21(1), 18 (1996).

tinguished Service in the Advancement of Polymer Science, The Society of Polymer Science, Japan (SPSJ), in 1983, the High Polymer Physics Prize of the American Physical Society in 1983, the West Japan Cultural Prize of the Nishinippon press in 1983, the Technical Award of the International Institute of Synthetic Rubber Producers in 1983, the M. L. Huggins Memorial Award of the Gordon Research Conferences in 1984 and the Award of the Society of Rheology, Japan in 1984. In 1996 Takayanagi was decorated with the Second Order of the Sacred Treasure (ZUHOUSHO).

Motowo Takayanagi was the President of the Society of Polymer Science, Japan (SPSJ) 1986-1988, and from 1989 he has been an Honorary Member of SPSJ. Since 1991, he is also an Honorary Member of The Society of Material Science, Japan. From 1981-1990, he was a Member of the MITI Evaluation Committee for High Performance Polymers and a Director of the Asahi Glass Foundation from 1990 to 1994.

Throughout his life Motowo Takayanagi was fascinated with philosophy, poetry and art. His high skill in calligraphy with brush and ink led him into poetry, *Haiiku*, the 5-7-5 and *Waka*, the 5-7-5-7-7 poems. He is also much interested in the great influence that Old Chinese Culture had on the Japanese Culture as seen in *Kanji* (Chinese Characters). Takayanagi is also involved in trying to understand some of the functions of the brain, especially in philosophical terms.

In April 1954, Motowo Takayanagi married the former Toyoko Imamura of Fukuoka. They have two children, Takashi and Hitoshi.

This article was prepared by **Tisato Kagiya**, Department of Materials Physics and Chemistry, Kyushu University, Fukuoka, Japan, and **Otto Vogl**, Department of Polymer Science and Engineering, University of Massachusetts, Amherst, MA, 01003, USA.