

The First Sivaram Endowment Lecture

Precision Polymerizations and Precision Synthesis of Designed Functional Polymers

by

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Abstract

This lecture will discuss the development of precision (living) polymerizations and synthesis of designed functional polymers and advanced polymer materials, not simply to look back into the past but to look forward to the future of Polymer Chemistry. The current efforts in the area of precision polymerization include: (a) the design of active, versatile, sustainable, and user-friendly catalysts that allow living radical polymerization of functional monomers; (b) new strategies for functional polymer synthesis; (c) industrial applications for novel materials that can be obtained uniquely by living polymerization; and (d) approaches to "sequence-controlled" macro molecules. We have recently reported a family of precision random copolymers that undergo interesting "single-chain folding" and controlled multi-chain aggregation to converge to single sized spherical structure. The key is a combination of hydrophobic and hydrophilic or fluorous methacrylates that are to be randomly copolymerized into copolymers of controlled and uniform compositions. Some of these copolymers form single-chain folded structures in water, where the inner core comes from hydrophobic repeat units covered by hydrophilic repeat units, thus leading to a nano-space in the core.

A more recent effort in this field concerns control of repeat-unit sequence in a chain-growth polymerization and related polymer-forming processes. An example involves a "single monomer-addition" process with a bulky and transformable monomer with which sequence-controlled macromolecules based on a carbon-chain backbone (such as polymethacrylates) can be realized.

About the speaker

Professor Mitsuo Sawamoto received his B.S., M.S., and Ph.D. degrees from Kyoto University working in the renowned school of Professor Higashimura, a pioneer in polymer science research and education in Japan. After a brief stay as a postdoctoral fellow at the Institute of Polymer Science, The University of Akron, Akron, Ohio with Professor J.P. Kennedy, he joined the faculty of Department of Polymer Chemistry, Kyoto University in 1981; eventually becoming a professor in the same department and a worthy successor to his illustrious mentor.

Professor Sawamoto has published over 350 original papers, 40 review articles and 45 patents. His publications have received more than 17,000 citations. His first paper on living radical polymerization has been cited over 3000 times and is ranked #2 among the most cited papers published in *Macromolecules*. Professor Sawamoto was ranked #1 in Japan and #3 in the world among the most cited scientists in organic and polymer chemistry for the period of 1997–2001.

He has been widely decorated, both, within and outside Japan for his exceptional contributions to polymer science. He is the recipient of the Medal of Honour with Purple Ribbon from the Japanese Emperor and the Prime Minister of Japan in 2015. He has been active in public service to the scientific community, holding leadership positions in the Society of Polymer Science, Japan and IUPAC. He has served on the editorial board of many scientific journals devoted to polymer science.

His research interest includes development of novel precision polymerizations and catalysis, synthesis of designed functional polymers, the nature of polymerization intermediates and sequence regulation in chain-growth polymerization for single-chain functional macromolecules.

About Dr. S. Sivaram

Dr. Sivaram is a polymer chemist, mentor and science manager of distinction. An alumnus of IIT-Kanpur (M.Sc. 1967), he received his Ph.D. in Chemistry from Purdue University, W. Lafayette, Indiana, USA in 1971. He was a Research Associate with Professor J.P. Kennedy at the Institute of Polymer Science, the University of Akron, Akron, Ohio during 1971-73. Dr. Sivaram returned to India to begin his scientific career in polymer industry and moved to National Chemical Laboratory (CSIR-NCL) in 1988 to lead the Polymer Chemistry Division. He later rose to the position of Director of this Laboratory from 2002-10. He is widely recognized for his contributions to polymer science, technology development, institution building and management of innovation in publicly funded organizations.



Dr. Sivaram is a recipient of many honours for his scientific contributions as well as leadership roles he has played in India. He is an elected fellow of all the learned academies of science and engineering in India. The President of India conferred on him the civilian award Padma Shri in recognition of his contributions to the nation. The Institute of Polymer Science, University of Akron honored him with the H.A. Morton Distinguished Professorship in 2006. Purdue University conferred on him an honorary degree of Doctor of Science in 2010 in recognition of his exceptional merit and attainment. IIT Kanpur bestowed on him the distinguished alumnus award in 1998.

Dr. Sivaram has played a stellar role in creating the Society of Polymer Science, India and has nurtured it from its very inception to make it a vibrant forum for scientists and students involved with the discipline of Polymer Science in India. He built a strong research school in Polymer Chemistry at NCL and brought global visibility, both, from academia and industry to the activities of his group. He has trained a large number of students who occupy influential positions in, both, academia and industry, in India and outside. Through his myriad activities over four decades, Dr. Sivaram has brought respect to this discipline within India amongst those practicing chemistry research, enhanced the global visibility for Indian polymer science research and is one of the most visible and influential faces of polymer science in India, in academia, government and industry.

About Sivaram Endowment Lecture

Dr. Sivaram endowment lecture has been instituted by his large family of students, associates, colleagues, mentors and well-wishers from across the world, both from academia and industry. The main objective of this lecture is to popularize polymer science and technology in the country and to inspire young researchers working in the area of chemistry, in general, and polymer science, in particular. The lecture shall be held once in two years during the biannual MACRO conferences held under the auspices of The Society for Polymer Science, India (SPSI). The Lecturer will be encouraged to visit educational institutions in India to interact with young students and inspire them. The Society will strive to invite distinguished scholars from India and abroad to deliver the endowment lecture. We, his former students and associates, believe that this is the most fitting way to acknowledge the values that Dr. Sivaram has instilled in us, namely pursuit of excellence in scientific research and education, maintaining the high standards of professional integrity and service to the scientific community.