

The Second Sivaram Endowment Lecture

C1 and C3 Polymerizations: Ways to Unprecedented Structures

by

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Thuwal, Kingdom of Saudi Arabia

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Time: 10.45 am

Venue: MACRO-2018 at C.V.Raman Auditorium
Indian Institute of Science Education and Research,
Pune

Organized by:

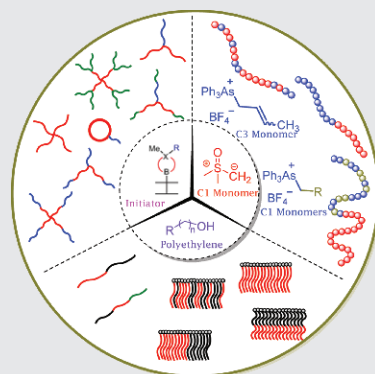


The Society for
Polymer Science, India

Abstract

In contrast to the well-known C2 polymerization of vinyl monomers (the chain is growing by two carbons at a time) and C4 polymerization of dienes (the chain is growing by four carbons at a time), the borane initiated polymerization of sulfoxonium and arsoniumylide monomers are leading to C1 (the chain is growing by one carbon at a time)¹ and C3 (the chain is growing by three carbons at a time)² chains, respectively.

By using appropriate ylides and trialkylboranes we were able to direct the polymerization either to C1 (dimethylsulfoxoniummethylide) or C3 (methylallyltriphenylarsoniumylide) mode. These findings open new horizons towards the synthesis of polyethylene (PE)- and polymethylallyl-based unprecedented polymeric materials³⁻¹⁴. A few of them are given in Scheme 1.



○ -CH₂- ○ C3 unit ○ substituted C1 ○ poly(norbornene) unit
~ PE block ~ & ~ PS, PMMA, PEG, PCL, PLA, etc.

Scheme 1. PE- and polymethylallyl-based polymers with complex macromolecular architectures

References

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About the speaker

Professor Nikos Hadjichristidis, a native of Greece had his early education in Greece. He completed his doctoral degree from the University of Liege, Belgium under the supervision of Professor Victor Desreux, Professor of Physical Chemistry and Polymers in 1971. His doctoral work was on the synthesis and solution properties of polymethacrylate esters. He then proceeded to the National Research Council of Canada at Ottawa for his post-doctoral research with Jacques Roovers on polyisoprene star polymers with 4 and 6 arms. It was here that he was initiated into the art of living anionic polymerization and the ability to work with high vacuum techniques. He began his academic career at the University of Athens in 1973. It was at Athens that he established his world-famous laboratory for anionic polymerization for the synthesis of novel homo- and copolymers with different and unique macromolecular architectures. Those polymers which required a lot of time/efforts to prepare were novel and necessary for the study for the effect of architecture on the polymer properties in solution and in bulk. He established wide collaboration with universities such as MIT, UMass, Princeton, Max Planck in Mainz and companies like Exxon-Mobil. The term, miktoarm star polymers, was christened by him (*mikto* in Greek means mixed). His research has focused mainly on the synthesis of novel model homopolymers, copolymers with *well-defined complex macromolecular architectures* (star, comb, cyclic, dendritic, etc) by using anionic polymerization (AP) techniques, as well as combinations of AP with other living and



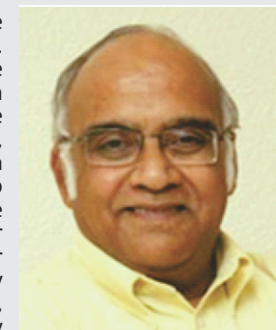
controlled/living polymerization methodologies (polyhomologation, ATRP, RAFT, NMP, ROP, ROMP, catalytic, etc). These polymers are ideal models for validating theory, understanding and improving the performance of industrial polymers (e.g. polyethylene, polystyrene based thermoplastic elastomers) and are potential candidates for high-tech applications (e.g. nanolithography, drug delivery, high temperature membranes).

Professor Hadjichristidis has published more than 500 scientific papers in referred scientific journals (h-index: 70) and 25 patents. He is the editor of three books and author of one book on "Block Copolymers" (Wiley 2003). After his retirement from the University of Athens in 2010 he moved to KAUST where he leads a flourishing research program on polymer synthesis. Professor Hadjichristidis is acknowledged as the world's most accomplished practitioners of the art and science of precision polymer synthesis.

He has been recognized by many awards and prizes, notable amongst them being, Macro Group United Kingdom Medal for Outstanding Achievement, UK, 2016, American Chemical Society National Award for Polymer Chemistry, USA, 2015, Chemistry of Thermoplastic Elastomers Award of ACS, Rubber Division, USA, 2011, International Award of the Society of Polymer Science, Japan, 2007, Milkovich Memorial Lecturer, Institute of Polymer Science, University of Akron, USA, 2006 and Arthur K. Doolittle Award of ACS Division of Polymer Materials: Science and Engineering, USA, 2003. He was conferred Doctor of Science, Honoris Causa by Simon Bolivar University, Caracas, Venezuela, 2010 and the University of Ioannina, Greece, 2010. He serves on the editorial board of many scholarly journals, such as, Polymer Chemistry (RSC), European Polymer Journal, Progress in Polymer Science, Journal of Polymer Science and Macromolecules (ACS).

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 (NCL) in 1988 to lead the Polymer Chemistry Division. He rose to become the Director of this Laboratory from 2002-10. He is widely recognized for his contributions to polymer science, technology development, fostering industry-academic collaborations, 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, The University of Akron honoured 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 2000. He received the International Award of the Society of Polymer Science, Japan, 2017 and will receive the Gold Medal of the Chemical Research Society of India for the year 2019 for his life time contributions to research in Chemistry.

Dr Sivaram has played a stellar role in creating and nurturing the Society of Polymer Science, India from its very inception and make it a vibrant forum for scientists and students involved with this discipline 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 for the discipline of polymer science in India amongst those practicing chemistry research, enhanced the global visibility for Indian polymer science research and is the 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.

First Sivaram Endowment Lecture:

Professor M. Sawamoto, Kyoto University, Japan, Thiruvananthapuram, January 8, 2017