Professor Palit's Memorial Lecture

Changing Landscape in Polymer Research: Challenges and Opportunities

by
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Abstract

Polymer research landscape has changed significantly in last 15 years. The polymer conversion industries have reached a level of maturity with an almost irreversible impact on fundamental research on polymer processing. No longer do we see full scale reports in current literature on the dynamics of screw extrusion, flow behavior in injection molding, rheological issues of stretch blow molding, or structure formation in film blowing, although no one believes that all fundamental problems in polymer processing have been unequivocally solved. The availability of funding largely dictates the scope of contemporary polymer research. Consequently, a large majority of active researchers are currently pursuing the unknowns in biomaterials processing or materials development in the areas of thin films, nanocomposites, multifunctional materials that change color, emit light, harvest solar energy, change shape on application of stimuli, etc. The fundamental principles of mass, momentum, and energy balances still apply to these new problems, but the length scales of interest are a now a few orders of magnitude smaller than what we are used to. In this talk, several examples will be presented to relate the length and time scales to polymeric materials performance in applications involving hysteresis in rubber compounds, drug delivery, air clarification, and coalescing filtration. In the first example, polymer building block synthesis from monomers and their organization in the mesoporous macroscale structures will be discussed in relation to airborne nanoparticle filtration as well as drug release. In the second example, nanoscale surface engineering of carbon black particles will be discussed with the objective of obtaining low rolling resistance rubber compounds. The third example discusses the use of polymer nanofibers with interpenetrating network morphology in removing water droplets from ultralow sulfur diesel fuel where a balance of surface energy and surface area is a key parameter.

About the speaker

Professor Sadhan C. Jana is currently professor and chair of the Department of Polymer Engineering at The University of Akron. He received his early education in chemistry with a B.Sc. Honors from R.K. Mission Residential College, Narendrapur and in chemical engineer- ing with a B.Tech. degree from University of Calcutta. He subsequently received M.Tech. and Ph.D. degrees in chemical engineering respecti-vely from IIT Kanpur (1988) and Northwestern University (1993), obtained post-doctoral training in the laboratory of Professor Andreas Acrivos at CUNY, and worked as a senior chemical engineer at General Electric Corporate Research Center for four years before joining the University of Akron in 1998 as an assistant professor. He rose through the academic ranks and became professor in 2007. Professor Jana is the recipient of National Science Foundation Faculty Early CAREER Award, Chemcon Distinguished Speaker Award, Society of Plastics Engineers (SPE) Fred E. Schwab Award for outstanding achievements in education, Honorary Professorship from National University of Colombia, Bogota, and George Stafford Whitby Award for distinguished research and education from the Rubber Division of the American Chemical Society. He is a Fellow and Honored Service Member of SPE, editor-in-chief of Springer Materials: Polymer Section and is an associate editor of Polymer Engineering & Science. In addition, he serves in the editorial boards of a number of peer-reviewed journals. Professor Jana currently leads research programs on novel applications of polymeric aerogels, polymer nanofibers, nanofiber templated synthesis of inorganic oxide photocatalysts, and reduction of hysteresis loss in tire tread compounds.

About Prof. S.R. Palit

Prof. Santi Ranjan Palit was born in Calcutta on the 24th March, 1912. In 1931 he came out First in First Class in the B. Sc. examination and the same performance was repeated in the M Sc. examination in Pure Chemistry of the Calcutta University. The next two years after passing the M Sc. examination was a period of agony of joblessness to him, since his mother (a follower of Mahatma Gandhi) opposed to allowing his son joining any Government service under the then British Government. At long last it was through the intermediary of Dr. Shyama Prasad Mukherjee that he got a research fellowship at the Department of Pure Chemistry of Calcutta University under Prof. J. N. Mukherjee, (a renowned colloidal chemist) and published his first paper in 1933 on cataphoretic speed of colloid particles. But he left it after one year to join the Vidyasagar College as lecturer where he spent two years and then wrote a book on Elementary Physical Chemistry. In 1938 he joined the Lac Research Institute, Ranchi as a Research Assistant under Dr. H. K. Sen where he got exposed to the fascinating world of paints, varnishes, lacquers etc. The first paper on Cosolveney came out from there in 1940 and subsequently he received P. R. S and D. Sc degree of Calcutta University. Prof. Mc-Bain of the University of Stanford, California invited him to search solvents for soaps and in early 1945 he joined in McBain's laboratory working as a Bristol-Meyer Research Associate. Prof. McBain had a great admiration to him quoting "Palit has a special ability to look at a familiar thing from an unfamiliar angle". After that he started to work with Prof. Herman Mark at the Polymer Institute at Brooklyn as a part-time researcher after a full time service at the research laboratory of E. F. Drew & Company, a leading manufacturer of oil derivatives. He then started the work on cosolvency of high polymers and made vast experience on the rapidly developing branch of Polymer Science. On the basis of work done there he was given the P.R.J.C award. Mention may be made of two very successful co-workers of him at that time, who was Bruno Zimm, famous for Zimm plot and Turner Alfrey.

In 1947 amidst the climax of dawning independence, he came back to India. At that time Prof. Meghnad Saha, the then President of the Indian Association for the Cultivation of Science (IACS) was organizing the Association in a new and promising manner befitting a leading research centre with emphasis on high polymers. Immediately he appointed S. R Palit first as a planning officer and then as a Professor of Chernisty. Thus started the Physical Chemistry Department of the I.A.C.S. housed in a single room and a verandah of the then dilapidated premises at 210 Bowbazar Street, Calcutta. At 1950 IACS shifted to Jadavpur where he made a good school of polymer and physical chemistry. Regarding the Professor's activities on polymers, it will not be irrelevant to quote Prof. Herman Mark:" ..... during his (Palit's) activities at his institute in Calcutta he (Palit) developed into the leading polymer scientist in India and in fact, the most prominent representative of this discipline in the far East. His numerous publications and his successful and convincing delivery of many lectures at International Conferences continued to increase his reputation and made him to become a recognized member of the small group of leading polymer scientists in the entire world". He worked as a Guest Professor in Berlin 1965-66 and in 1966 he was a visiting Professor at the University of Florida, USA. He became a fellow of the Indian National Science Academy (F. N. A) and a fellow of the Indian Academy of Sciences (F. A. Sc.). Number of successful doctoral students guided by Prof. Palit till 1975 was 80, but he stayed at IACS as emeritus professor till 1981 and guided about another 20 students His last three students were awarded the degree in 1980-1981. He published more than300 papers, monographs etc and his most important contributions are particularly polymerization kinetics including chain transfer and dye partition techniques for detection of polymer end groups, (ii) Anomalous (non-Faradaic) electrolysis, nonaqueous titration etc. He died on 14 th August 1981 at calcutta after his coming back immediate from London delivering /demonstrating a talk on non-Farady electrolysis at Royal Society keeping a group of eminent polymer scientists working both in academic and industry in the country.

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