# Fourth Palit Memorial Lecture 2022

## Reactive Self-Assembly of Polymers and Proteins for Therapeutic Applications

by **Prof. S. Thayumanavan** University of Massachusetts Amherst

Date: December 12, 2023 Time: 09:00 am to 09:45 am

Venue: MACRO-2023 at Bhupen Hazarika Auditorium IIT Guwahati

### Organized by:



The Society for Polymer Science, India

## Abstract

Direct use of proteins, to address a specific deficiency, has the promise to mitigate the off-target effects of typical drug molecules. The show-stopper here is that these therapeutic proteinsare not accessible for on-target delivery. Most current approaches are restricted to delivery of extracellular proteins (*e.g.* insulin). This leaves behind a rather large number of pathologically important intracellular proteins. We report a novel self-assembly protein shrink-wrapping strategy that addresses key shortcomings of prior approaches. Here, the protein itself acts as the template for the polymer to self-assemble around it. Because the protein is the central component in the self-assembly, protein loading is high. Moreover, the polymer is designed such that the assembly is non-toxic, not prone proteolytic degradation in serum conditions, but releases the protein cargo in the cytosol with complete retention of their structure and function. Complementary approaches taken in this regard will also be discussed.



### About the speaker

S. "Thai" Thayumanavan is a Distinguished Professor in the Department of Chemistry and the Department Head of Biomedical Engineering at the University of Massachusetts Amherst. He is also the Director of Center for Bioactive Delivery at the Institute for Applied Life Sciences at UMass. He received his B.Sc. and M.Sc. degrees from The American College in Madurai, India. He received his Ph.D. from the University of Illinois at Urbana-Champaign in 1996. Following a postdoctoral stint at Caltech, he started his independent career at Tulane University in 1999 and moved to UMass Amherst in 2003.



The Thayumanavan lab is interested in translating novel polymer-based molecular assemblies into innovative materials to make a lasting impact in biomedical applications. His research group develops fundamental design guidelines for self-assembled systems that predictably respond to specific cues. These guidelines are used in enabling applications in a variety of areas including self-healing materials, autonomously functioning systems, drug delivery, intracellular delivery of biologics, and cryptic catalysis. His work has resulted in more than 280 peer-reviewed publications in high-impact journals. The innovation in his work has also produced nearly 20 patents and patent applications. Thayumanavan has received numerous national and international recognitions for his creative contributions. These include the CRSI Medal from the Chemical Research Society of India, Manning Life Sciences Prize and elected fellow of the American Association for the Advancement of Sciences. He has also launched two start-up companies based on technologies developed in his laboratory - Cyta Therapeutics is focused on solving complications based on metabolic diseases including obesity; Marunthu Therapeutics is focused on developing targeted nanomedicine for cancer therapeutics.

## About Prof. S.R. Palit

Prof. Santi Ranjan Palit was born in Calcutta on 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 MSc. examination in Pure Chemistry of the Calcutta University. The next two years after passing the MSc. 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 Chemistry. 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 than 300 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.

The fund for Prof. S.R. Palit award of SPSI has been raised by members of Kolkata Chapter from the organization of national (Polymer-2006) and International (Macro-2015) conferences at IACS, Kolkata.

## **Earlier Lectures**

2017: Professor Sadhan C. Jana, University of Akron, Akron, Ohio, USA. 2018: Professor Chi Wu, The Chinese University of Hong Kong. 2020: Professor Yves Gnanou, King Abdullah University of Science and Tech

2020: Professor Yves Gnanou, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia