

Special Seminar

Transforming Water: Innovations in Materials, Droplets, and Ice From scalable purification technologies to new discoveries in water and ice chemistry

Dr. Thalappil Pradeep

Institute Professor
Indian Institute of Technology Madras



Abstract: Sustainable nanotechnology plays a vital role in providing contaminant-free water to humanity. In this talk, I will present the discovery of affordable and sustainable nanomaterials capable of selectively removing arsenate and arsenite ions—as well as other contaminants—from water, reducing their concentrations below permissible drinking water limits. This development led to a widely implemented technology known as AMRIT (meaning "elixir" in Sanskrit), which currently delivers 80 million litres of arsenic-, iron-, and uranium-free water every day to 1.4 million rural people, at a cost of just 2.1 paise (US\$0.00026) per litre—the lowest in the world. The technology has been approved for national deployment.

We have also developed several other technologies for detecting and removing contaminants in water. A brief overview of these efforts, along with future directions, will be shared.

In parallel, our investigations into the new chemistry in water droplets and the science of ice have revealed several unexpected findings. A few illustrative examples from these emerging areas will also be presented.



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9:30am



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Pradeep T. Bio

Thalappil Pradeep is an Institute Professor at the Indian Institute of Technology Madras (IITM), Chennai, India. He is the Deepak Parekh Institute Chair Professor and is also a Professor of Chemistry. He studied at the University of Calicut, Indian Institute of Science (IISc), UC Berkeley, and Purdue. His research interests are in molecular and nanoscale materials. He is an author of over 590 scientific papers in journals and is an inventor of over 100 issued patents. He is involved in the development of affordable technologies for drinking water purification and some of them have been commercialized. His pesticide removal technology has reached about 10 million people. His arsenic removal technology, approved for national implementation, is delivering arsenic free water to about 1.4 million people every day. Along with his associates, he has incubated seven companies and three of them have production units. He is the recipient of several awards including the Shanti Swaroop Bhatnagar Prize, BM Birla Science Prize, National Award for Nanoscience and Nanotechnology, India Nanotech Innovation Award, JC Bose National Fellowship and National Water Award. He has won The World Academy of Sciences (TWAS) prize in Chemistry for the year 2018. Nation conferred the civilian award, Padma Shri on him in 2020. He is also a recipient of the Nikkei Asia Prize, Prince Sultan Bin Abdulaziz International Prize for Water, VinFuture Prize and ENI award. Recently, he has won the International Excellence Award of Karlsruhe Institute of Technology, Germany and the Fellowship of Schroff Foundation. He is a Fellow of all the science and engineering academies of India, TWAS, American Association for the Advancement of Science, African Academy of Sciences, US National Academy of Engineering and Academia Europaea. He has authored the introductory textbook, Nano: The Essentials (McGraw-Hill) and is an author of the monograph, Nanofluids (Wiley-Interscience) and an advanced textbook, A Textbook of Nanoscience and Nanotechnology (McGraw-Hill). He was/is on the editorial boards of journals such as ACS Nano, Chemistry of Materials, Analytical Chemistry, Chemical Communications, Nanoscale, JPC Letters, etc., and was an associate editor of ACS Sustainable Chemistry & Engineering for ten years. He is now an Associate Editor of ACS Sustainable Resource Management. He has authored popular science books in English and Malayalam and is a recipient of Kerala Sahitya Akademi Award for knowledge literature. He has received the Lifetime Achievement Research Award of IITM and Distinguished Alumnus Award of IISc. As part of philanthropy, he supports a school in his village where 500 students are on rolls.

Key papers:

Clean water through nanotechnology: Needs, gaps, and fulfillment, Ankit Nagar and T. Pradeep, ACS Nano, 14 (2020) 6420–6435. DOI: 10.1021/acsnano.9b01730

Confined metastable 2-line ferrihydrite for affordable point-of-use arsenic-free drinking water, A. A. Kumar, A. Som, P. Longo, C. Sudhakar, R. G. Bhuin, S. Sen Gupta, Anshup, M. U. Sankar, A. Chaudhary, R. Kumar, and T. Pradeep, Adv. Mater. 2017, 29, 1604260 (1-7). DOI: 10.1002/adma.201604260

Biopolymer reinforced synthetic granular nanocomposites for affordable point-of-use water purification, M. U. Sankar, S. Aigal, A. Chaudhary, Anshup, S. M. Maliyekkal, A. Anil Kumar, K. Chaudhari, and T. Pradeep, Proc. Natl. Acad. Sci., 110 (2013) 8459-8464. DOI: 10.1073/pnas.1220222110

B. K. Spoorthi, Koyendrila Debnath, Pallab Basuri, Ankit Nagar, Umesh V. Waghmare, and Thalappil Pradeep, Spontaneous weathering of natural minerals in charged water microdroplets makes nanomaterials, Science, 384 (2024) 1012-1017. DOI: 10.1126/science.adl3364