

Polymer Seminar

Friday, October 25, 2024

11:15 am Science 1 - Room 1002

Coffee, Tea, and Cookies will be available at 11:00 am



Dr. John Kataras

Research & Development
Oak Ridge National Laboratory

Host: Mu-Ping Nieh

Membranes as Supramolecular Structures for Biological Memory

Abstract: Biological cells are bounded by plasma membranes (PMs), supramolecular assemblies of lipids and proteins that separate a cell's interior from its external environment. Although the existence of cells has been known since the mid-19th century, it was not until the early part of the 20th century that the underlying structure of the PM began to emerge. Lipid bilayers have also been found to exhibit synaptic plasticity, a feature associated with biological learning and memory. In 2022, we discovered that lipid bilayers are capable of long term synaptic plasticity not unlike long term potentiation (LTP) observed in mammals and birds. Most recently, we have observed that lipid bilayer when exposed to electrical stimulus, also exhibit short term synaptic plasticity. Our data thus support the interpretation that the lipid bilayer provides a model for understanding the molecular basis of biological memory. I will describe the droplet interface bilayer system, which has enabled us to understand the neuromorphic capability of membranes and how we will develop and use liquid-liquid neutron reflectometry to gain molecular insights into the metastable structures that give rise to biological memory and learning.

Bio: John has a broad academic background that has enabled him to develop, lead, collaborate, and successfully conduct interdisciplinary research for the past 35 years using different scattering (light, x-rays, and neutrons) and biophysical (calorimetry, spectroscopies) techniques, combined with computer simulations. Over the past 25 years, John, with his students and colleagues, has developed neutron scattering models to analyze neutron scattering data and experimental approaches to detect nanoscopic lipid domains. Starting in 2020, John and his collaborators have been studying lipid bilayers as potential neuromorphic platforms which exhibit persistent synaptic plasticity in the form of long-term potentiation (LTP), a feature associated with learning and memory.

Since 1998, John has supervised numerous postdoctoral students who have gone on to have significant scientific careers of their own as professors at universities and staff scientists/directors at national labs/government agencies, and who are known, both nationally and internationally, for their own scientific contributions and achievements. He has presented over 200 invited talks (16 plenary/keynote lectures) and reviewed for a wide range of journals and scientific organizations. Currently, he is associate editor for Chemistry and Physics of Lipids and on the editorial board of Biochimica et Biophysica Acta - Biomembranes and Membranes. John is fellow of the Neutron Scattering Society of America (NSSA) and the American Institute for Medical and Biological Engineering. In 2022, John was the recipient of NSSA's Sustained Research Prize.