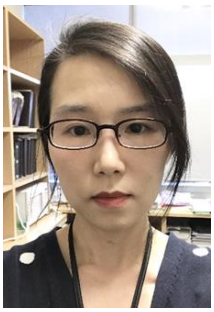
Department of Chemistry & Biochemistry Seminar

Friday, April 16th, 2021

1:30pm – 2:45pm

Zoom ID:960 452 0800

Password: Emulsions



Multimodal Single Entity Electrochemistry of Nanoemulsions: Fundamentals and Applications

Speaker: ***Dr. Jiyeon (Jay) Kim, University of Rhode Island***

Abstract: Nanoemulsions (NEs) have widely emerged as important nanoscale platforms for various applications in biology, physiology, analytical sensing, electrocatalysis, and industry for drug/food/cosmetic/fuel combustion. Despite the multitude of applications, it, however, is not fundamentally understood how heterogeneous ion- or electron-transfer reactions at NE interfaces are affected by the interfacial structure, physicochemical properties, and thermodynamic selectivity. Problematically, the lack of this fundamental understanding limits the extensive applications, and even ruins the reproducibility and reliability of these intriguing nanoscale systems. We have recently explored new experimental strategies, multimodal single entity electrochemistry (SEE) to investigate ion- or electron-transfer reactions across the interface at individual NEs for a greater fundamental understanding and better practical application of nanoelectrochemistry at the liquid/liquid interface. Single entity electrochemistry is a powerful method to study one thing at a time by electrochemical means. We uniquely employed SEE combined with voltammetry, amperometry or potentiometry, i.e., multimodal SEE to study charge transfer reactions at the NE interface featured with various compositions of surfactants, which enables the first unequivocal kinetic and thermodynamic studies at the nanoscale liquid/liquid interface of individual NEs, and the fundamental elucidation of interfacial structures at the molecular level as well as a partition coefficient at an individual intact NE. Based on these fundamental understandings, practical aspects of NEs were then explored for ionophore based potentiometric or amperometric sensing, and ionophore-free nanoextractors with ultrahigh sensitivity in biomedical and environmental electroanalysis. Our most recent results and promising perspectives in these multimodal SEE methods will be discussed.

Biography: Jay Kim was educated at Ewha Woman's University (BS, MS Chem 2001) in Korea, and worked at Korea Institute of Science and Technology (KIST) as a researcher (2003-2004) with conducting research on the development of additives and electrochemical cells for secondary lithium ion batteries with enhanced capacity. She joined the group of Shigeru Amemiya at the University of Pittsburgh (Ph.D. 2012) investigating development and applications of nanoscale scanning electrochemical microscopy (nanoSECM). Then, she joined the group of Allen J. Bard (2013-2016) at the University of Texas at Austin as a Postdoctoral researcher studying nanoelectrochemistry in electroanalysis, electrocatalysis and microbiology. In 2016, she started as an Assistant Professor at the University of Rhode Island in the Analytical Chemistry Division. Currently, her research group is interested in three areas. (i) Electron transport through a single metal-reducing bacteria and its nanowires for microbial fuel cells studied by nanoSECM (ii) Quantitative assessment on bacterial drug resistance at a single bacterium with nanoSECM (iii) Single entity electrochemistry of nanoemulsions for their fundamental understanding and practical applications in biomedical, environmental analysis, and electrocatalysis. Jay Kim is the recipient of the NSF Early CAREER Award (2021).