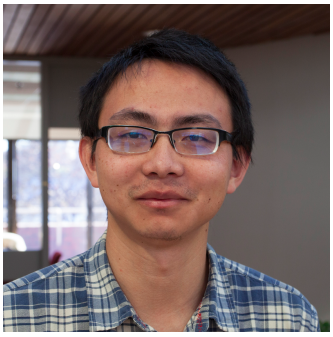
BRIGHAM AND WOMEN'S HOSPITAL
HARVARD MEDICAL SCHOOL

181 Longwood Avenue
Boston, Massachusetts 02115-5804

Department of Medicine
Channing Division of Network Medicine

Channing Network Science Seminar

April 29, 2016, 11am @ 5th floor conference room



Yanxin Jia, Ph.D.

Postdoctoral Fellow
Origins of Life Initiative
Department of Earth & Planetary Sciences
Harvard University

Electrochemical Micro-Oscillator Networks

Stationary and oscillatory patterns can arise on the surface of a single electrode and assemblies of discrete electrodes. In traditional macrocells, the geometry of the arrangement of the cathode, anode, and the reference electrodes determines the strength and length-scale of the effective coupling that affects the features of the observed self-organized pattern formation. To explore the temporal and spatial features of pattern formation in electrochemical devices with micro-electrodes, we have constructed epoxy-embedded electrodes with a poly-dimethyl siloxane (PDMS) flow cell. It is shown that the microcell design typically used in electroanalytical chemistry produces large ohmic drops that can induce oscillations during the uniform corrosion of Ni electrodissolution. Furthermore, the dynamical features of oscillatory Ni dissolution in sulfuric acid are investigated with 2-10 micro-electrode arrays. Equivalent circuit analysis is applied to formulate a theory for the electrical coupling strength between the electrodes as a function of the cell parameters: electrode surface area, length of the flow channel, and total cell resistance. The theory predicts a wide range of bidirectional positive, unidirectional negative, or unidirectional positive coupling depending on cell geometry. The predictions are tested in experiments with an on-chip integrated electrochemical cell that uses an epoxy-based substrate for 2-10 embedded metal wires with the PDMS fluidics. The network topology is extracted from the experiments with a phase model based coupling analysis. The results are discussed and design rules are formulated for tuning the dynamical characteristics of the chemical reaction system through intensifying or minimizing the coupling strength between the electrodes.

Bio: Yanxin Jia is a postdoctoral fellow in the Department of Earth and Planetary Sciences, Origins of Life Initiative at Harvard University, under the supervision of Prof.Juan Pérez-Mercader. His current research interests are using Top-down Synthesis approach to investigate an Ex-novo Chemical Artificial Living System. He earned his B.S degree in Chemistry from Nanjing University (China). In 2015 he earned his PhD in Chemistry from Saint Louis University (Saint Louis, Missouri) under the supervision of Prof. István Z. Kiss, where he worked on Collective behavior of oscillatory electrochemical reactions on micro scale.

Hosted by Yang-Yu Liu