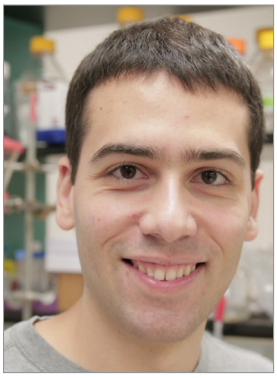
Department of Chemical
and Biological Engineering
UNIVERSITY OF WISCONSIN–MADISON

2020 Fall CBE Seminar Series

presents the:

Graduate Student Seminar



BENJAMIN GASTFRIEND

Improved Human Models of the Neurovascular Unit

Blood vessels are formed by a layer of endothelial cells surrounded by supporting mural cells. In the brain, blood vessels dynamically interact with neurons, astrocytes, and other brain cell types in a functional structure referred to as the neurovascular unit. Consequently, brain endothelial and mural cells have evolved specialized functions to regulate the neural environment. For example, endothelial cells form the blood-brain barrier (BBB), which tightly controls molecular and cellular transport between the blood and brain, but also limits brain uptake of most therapeutic molecules. Mural cells regulate endothelial BBB properties, and modulate blood flow in response to local metabolic demand. Further, brain endothelial and mural cell dysfunction is implicated in neurological diseases including multiple sclerosis (MS), Alzheimer's disease, and cerebral small vessel diseases. Knowledge of the molecular processes underpinning function and dysfunction of these neurovascular cell types, however, remains poor, due in part to a lack of appropriate human model systems. In this presentation, I will discuss our work using human pluripotent stem cells (hPSCs) to develop improved experimental models of brain endothelial cells and mural cells. hPSCs can generate these cells in large numbers and with high fidelity, and offer an otherwise inaccessible window into human development and disease processes. Specifically, I will discuss a new method to produce brain-like endothelial cells with improved expression of immune cell adhesion molecules. These cells are therefore suitable to study interactions between immune cells and the BBB, processes that likely contribute to MS and other autoimmune diseases. Second, I will present our work developing a protocol to differentiate brain mural cells from a developmentally-relevant progenitor.

ELLEN MURRAY

Evaluating the Role of Water Within the Electric Double Layer on Oxygen Reduction

The future of advanced energy-storage solutions relies on our ability to describe and tailor the fundamental interactions that occur at solid/liquid interfaces in electrocatalytic systems. Typically, the binding strength of reaction intermediates to a catalyst surface in the absence of solvent is a ubiquitous descriptor used to rationalize reactivity trends. However, this type of analysis fails to explain why Au(100), which binds oxygenates far weaker than the optimal catalyst, is one of the most active catalysts for the oxygen reduction reaction (ORR) in alkaline media. To provide atomistic insights on this complex behavior, we use *ab-initio* molecular dynamics simulations to study native and reconstructed electrified Au(100) surfaces in aqueous environments. We demonstrate that the complex bonding networks that form at the interface between water, reaction intermediates, and Au(100) surface reconstructions directly impact the stability of reaction intermediates bound to the surface, leading to enhanced ORR kinetics. These findings highlight the importance of solvents in electrocatalysis and contribute to the development of solvent-cognizant reactivity descriptors.

Tuesday, Oct. 20, 2020

Lecture at 4:00 p.m.

https://uwmadison.zoom.us/j/91376473708