



# **Old Dominion University**

## **Department of Physics**

**Colloquium**  
**Tuesday, September 1, 2015**

### **"Interdisciplinary Projects on Advanced Biochars, Biofuels and Bioenergetics"**

**James W. Lee, PhD**  
**Department of Chemistry and Biochemistry**  
**Old Dominion University**

The Lee Group at ODU often employ interdisciplinary approaches in their energy and environmental sustainability-related research. They are currently (1) developing advanced hydrophilic biochars with physical chemistry techniques such as the applications of ozone and O<sub>2</sub>/CO<sub>2</sub> plasma as a strategy to sequester carbon and retain soil nutrients and water for sustainability on Earth; (2) creating designer algae with synthetic biology and electroporation for genetic transformation to photobiologically produce advanced biofuels such as H<sub>2</sub> and butanol directly from water and carbon dioxide; and (3) achieving better fundamental understanding of proton-coupling bioenergetics by testing a newly proposed proton-electrostatics localization hypothesis that would significantly modify Mitchell's classic Chemiosmotic theory that earned him the Nobel Prize of Chemistry 1978. This presentation will outline the progresses that Lee Lab Group recently made on these research areas. The focus of this presentation will be on the proton-electrostatics localization hypothesis, which employs the Gauss Law equation as a mathematic thought experiment in identifying the site of localized protons in biological systems. To demonstrate the fundamental behavior of localized protons, we have recently generated excess protons and excess hydroxyl anions by utilizing an "open-circuit" water-electrolysis system and their distributions were tested using a proton-sensing membrane. The experimental result showed that excess protons indeed localize at the water-membrane interface in a manner similar to the behavior of excess electrons in a conductor as predicted by the proton-electrostatics localization hypothesis. This finding has significance not only in the science of bioenergetics but also in the fundamental understanding for the importance of water to life in serving as a proton conductor for energy transduction in living organisms.

Presentation: **OCNPS 200 @ 3:00 pm**  
Refreshments: **OCNPS Atrium @ 2:30 pm**

**All interested persons are cordially invited to attend.**

