

GEC15-2015-000025

Abstract for an Invited Paper
for the GEC15 Meeting of
the American Physical Society

Understanding Charge Transfer Reactions at the Interface of Plasmas in Contact with Liquids¹

DAVID GO, University of Notre Dame

Plasmas in and in contact with liquids offer a very rich physical and chemical environment where a multitude of species (electrons, ions, neutrals) and physical phenomena (light, electric fields) intersect. With emerging applications in medicine, environmental remediation, and materials synthesis, it has become paramount to understand the many processes occurring at the interface in order to design and optimize new technologies. Perhaps the most important plasma species is the electron, and it thus reasonable to assume it can play a critical role when plasmas are brought in contact with liquids as well. Over the past several years, our group has focused on deciphering the nature of electron transfer from a plasma to liquid and the subsequent chemistry the electrons induce. Our experimental configuration is the plasma equivalent of an electrochemical or electrolytic cell, where the cathode and anode are submerged in an electrolyte solution and current is carried by reduction reactions at the cathode and oxidation reactions at the anode. When the cathode is replaced by a plasma, the circuit is explicitly completed by the injection of plasma electrons into the solution where they stably solvate before inducing reduction reactions. Recently, we have demonstrated the first direct detection of these stably solvated electrons using a novel total internal reflection absorption spectroscopy experiment, resulting in the first measurement of the optical absorption spectrum for plasma-solvated electrons. Further, we have shown that the lifetime of these electrons can be significantly reduced if suitable solution- and plasma-phase scavengers are used to react quickly with these electrons. These results highlight the complexity of the plasma-liquid interface and how charge-transfer processes often compete with other chemistry that occurs at the plasma-liquid interface, such as the dissolution of plasma species into the liquid.

¹This work was supported by the U.S. Army Research Office under Award Number W911NF-14-1-0241.