Experimental Confirmation of Transport Model for Solvated Electrons in a Plasma Electrochemical System*

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In this work, the transport of the plasma injected solvated electron is studied using total internal reflection absorption spectroscopy (TIRAS). We previously measured the absorption spectrum for plasma injected electrons at the plasma-liquid interface, which aligns with results produced using nanosecond pulse radiolysis. A theoretical model is used to predict the reaction-diffusive penetration of these electrons, and recent work predicted a 1/3$\frac{1}{3}$ exponential scaling of TIRAS intensity with the plasma current density. In this work we perform TIRAS measurements while controlling plasma current density, with the objective of confirming this predicted 1/3$\frac{1}{3}$ scaling. By doing so, we find that at higher current densities a scaling of approximately 1/3 power is observed. However, the scaling is linear at lower concentrations, which we show is due to the transient response of the experiment operating in a modulated mode. Having been demonstrated, this scaling law can predict approximate limits of penetration and interfacial concentration for solvated electrons and hydroxyl radicals, allowing for the enhanced tailoring of a variety of plasma-liquid systems to their applications.

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