Abstract

Proton-coupled electron transfer (PCET) is an intriguing topic in the world of alternative energy conversion research. The topic simply refers to the shift of a proton and electron in a concerted fashion. While PCET is well known in reactions of molecules in their ground electronic state, it is much less frequently observed in reactions of excited states, where electron and proton transfer must occur during the lifetime of a photo excited reagent. Here specifically the compounds N-methyl-4,4'-dimethyl-2,2'-bipyridinium (Mdmb⁺) and N-methyl-1,10-phenanthroline (Mphen⁺), as hexafluorophosphate salts, were synthesized with the intention of learning further information regarding their ability to react with the excited state of the chromophore [Ru(bpy)₂(4,4'-dhp)]²⁺ (bpy = 2,2'-bipyridine; 4,4'-dhp = 4,4'-dihydroxy-2,2'-bipyridine). This poster will primarily focus on the synthesis and characterization of Mdmb⁺ and Mphen⁺ in particular. Based on data for the electrochemistry of Mdmb⁺, Mphen⁺ and [Ru(bpy)₂(4,4'-dhp)]²⁺ along with luminescence data for [Ru(bpy)₂(4,4'-dhp)]²⁺, it was determined that only excited state proton transfer is possible for Mdmb⁺ and only electron transfer is possible for Mphen⁺ in reaction with photo excited [Ru(bpy)₂(4,4'-dhp)]²⁺. These photochemical processes offer insight into the dynamics of systems where excited state electron and proton transfer reactions occur. Coupling these reactions to catalysts for water or CO₂ reduction will provide needed redox leveling sought by others interested in solar fuel research.

Conclusions and Future Works

- The mono-methylated diamine derivatives could be easily prepared without the doubly methylated species as an impurity.
- Both compounds have revealed interesting quenching data, which will require further investigation through spectroelectrochemistry and transient absorption experiments.
- Change in reduction potential with protonation suggests the possibility of proton coupled electron transfer in reaction with chromophores capable of donating both a proton and an electron.
- Voltammogram irreversibility’s indicates decomposition of the reduced molecule on the time scale of the voltammogram.
- In the future, we as a group will seek to investigate more alkylated diamine structures and their possible electron transfer/proton transfer quenching capability.

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