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Synergistic Effects of the Substrate-Ligand Interaction in Metal-Organic Complexes on the De-Electronation Kinetics of a Vitamin C Fuel Cell

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Abstract : The rising need for portable energy sources has led to advancements in direct liquid fuel cells (DLFCs) using various fuels like alcohol, ammonia, hydrazine, and vitamin C. Traditional precious metal catalysts improve reaction speeds but are expensive and prone to poisoning. Our study reveals how non-precious metal organometallic complexes, combined with smartly designed ligands, can significantly boost performance. The key is a unique interaction between the substrate (fuel) and the ligand, which creates a "dragging" effect that enhances reaction rates. By using this approach with a ferricyanide/ferrocyanide half-cell reaction, we developed a vitamin C fuel cell without precious metals. This fuel cell achieves an open circuit voltage of ~950 mV, a peak power density of ~97 mW cm^{-2}, and a peak current density of ~215 mA cm^{-2}. Impressively, its performance is about 1.7 times better than traditional precious metal-based DLFCs. This highlights the potential of substrate ligand chemistry in the creation of sustainable DLFCs for efficient energy conversion.

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