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Polymeric Binuclear Ruthenium Complex as Efficient Electrocatalyst for Oxygen Evolution Reaction

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Abstract:

A robust polymeric material constituted by chains of binuclear aqua ruthenium terpyridylphenanthroline complexes connected through benzene ring meta-positions, exhibiting an unusual two electrons and two protons PCET (proton-coupled electron transfer) process and enhanced oxygen evolution reaction (OER) activity, is described. The catalytic active [Ru^{V}=O] species is generated at potentials more positive than +1.5 V (NHE) in the poly-[{Ru(H_2O)(phen)}$_2$(tpy_2ph)] film, as confirmed by the rise of the ruthenyl (Ru^{V}=O) stretching band at 810 cm^{-1} in the Raman spectrum, and the clear change to a higher activity regime as confirmed by EIS. Faradaic efficiency for OER as high as 39% was achieved at +1.8 V, indicating that poly-[{Ru(H_2O)(phen)}$_2$(tpy_2ph)] is one of the most active ruthenium terpyridine complexes ever prepared. The synthesis and characterization of the monomeric binuclear [{RuCl(Clphen)}$_2$(tpy_2ph)]$^{2+}$ and its respective [{Ru(H_2O)(Clphen)}$_2$(tpy_2ph)]$^{4+}$ aqua complex are also fully described.

Keywords: Oxygen evolution reaction, ruthenium complex, binuclear catalyst, high valence complex, electrocatalysis, modified electrodes

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