

Supporting Information
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Ionic Liquid Enhanced Proton Transfer for Neutral Oxygen Evolution Reaction

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Equation S1:

$$\rho = \left(\frac{\partial \log(i)}{\partial \text{pH}} \right)_E$$

Equation S2:

$$C_{\text{ads}}(E) = \sigma \frac{d\theta(E)}{dE}$$

where σ is the charge density for a monolayer coverage (assumed to be constant), C_{ads} is obtained from the impedance spectroscopy and θ is the surface coverage.

Equation S3:

$$\frac{d \ln(i)}{d(1/T)} = -\frac{E_a}{R}$$

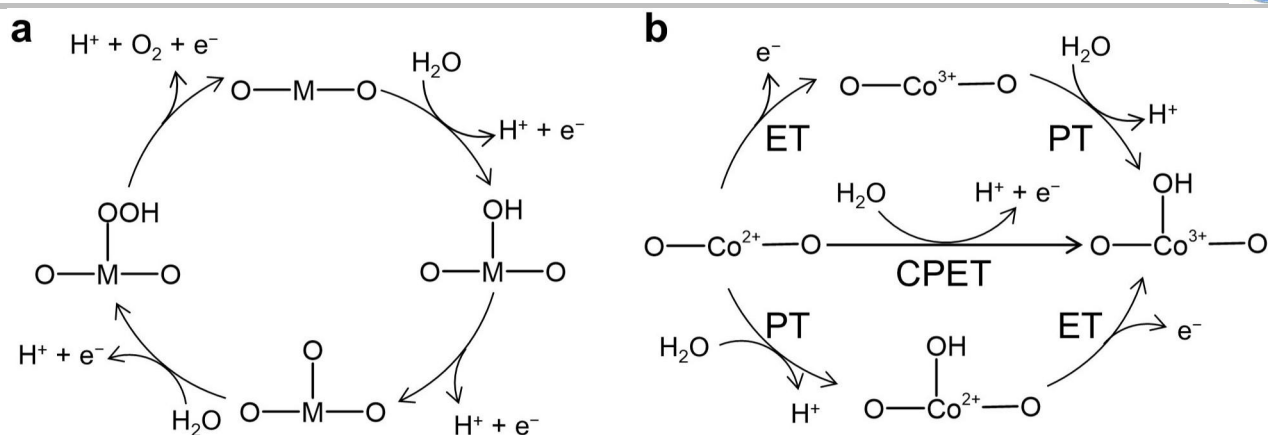


Figure S1 Schematic illustration of PCET steps for OER (a) and the CPET or ETPT/PTET pathways (b).

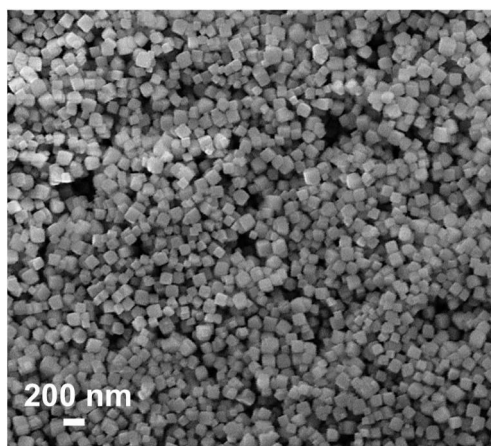


Figure S2 SEM image of the $\text{CoSn}(\text{OH})_6$.

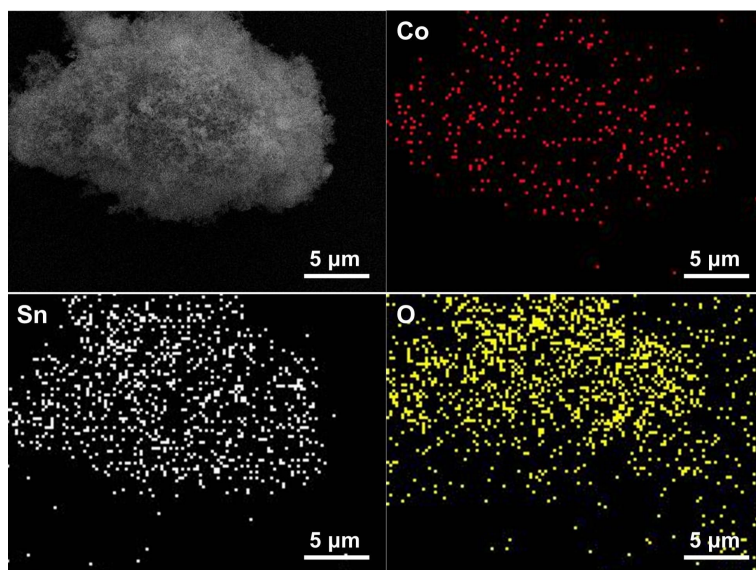


Figure S3 EDX mapping images of the CoSn(OH)_6 sample.

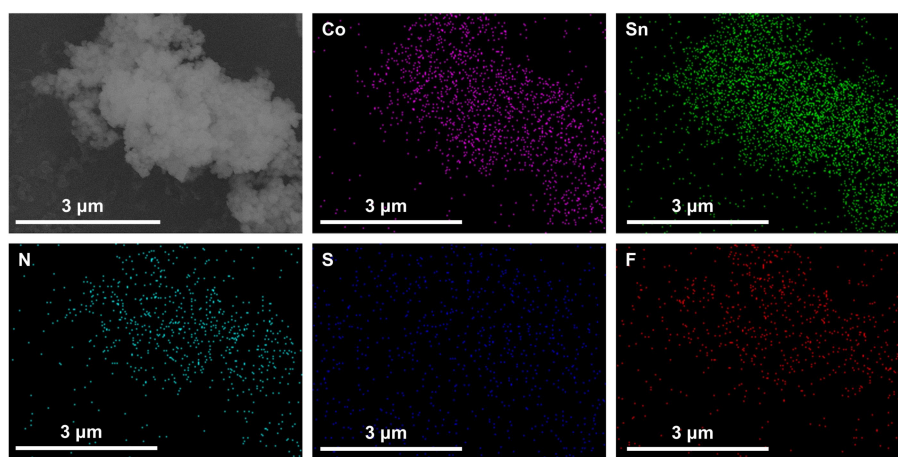


Figure S4 EDX mapping images of the $\text{CoSn(OH)}_6\text{-IL}$ sample.

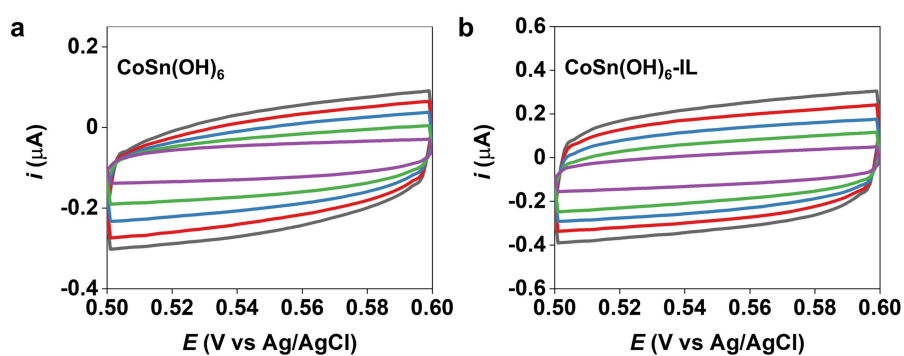


Figure S5 CV curves of the as-prepared CoSn(OH)_6 and CoSn(OH)_6 -IL electrode at different scan rates (0.01, 0.02, 0.03, 0.04 and 0.05 V s^{-1}).

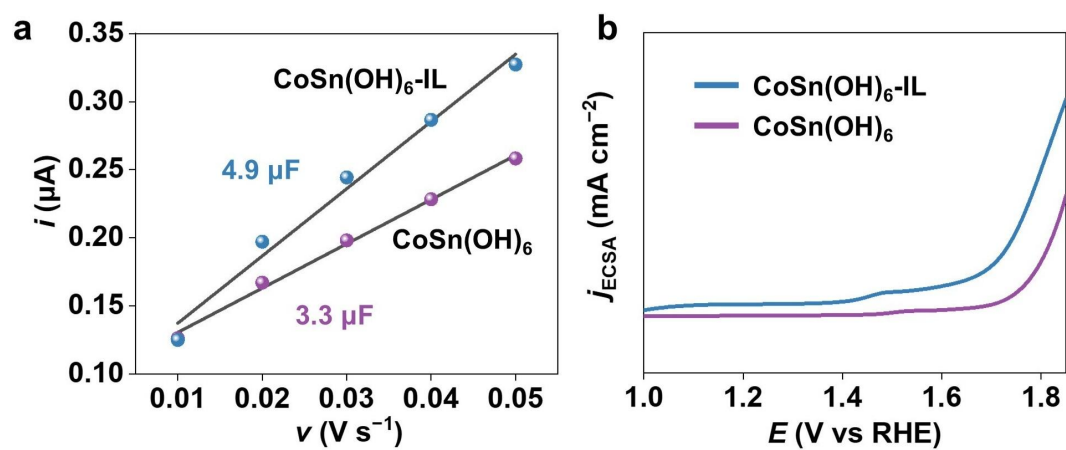


Figure S6 (a) The double-layer capacitance, (b) LSV curves normalized by ECSA of $\text{CoSn}(\text{OH})_6\text{-IL}$ and $\text{CoSn}(\text{OH})_6$.

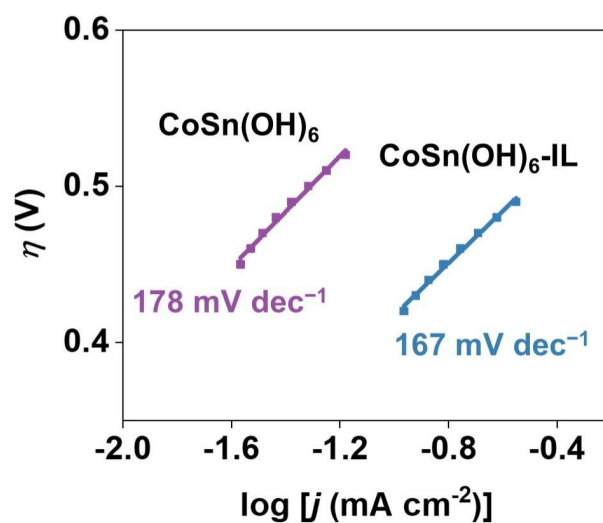


Figure S7 Tafel plots of CoSn(OH)_6 and $\text{CoSn(OH)}_6\text{-IL}$.

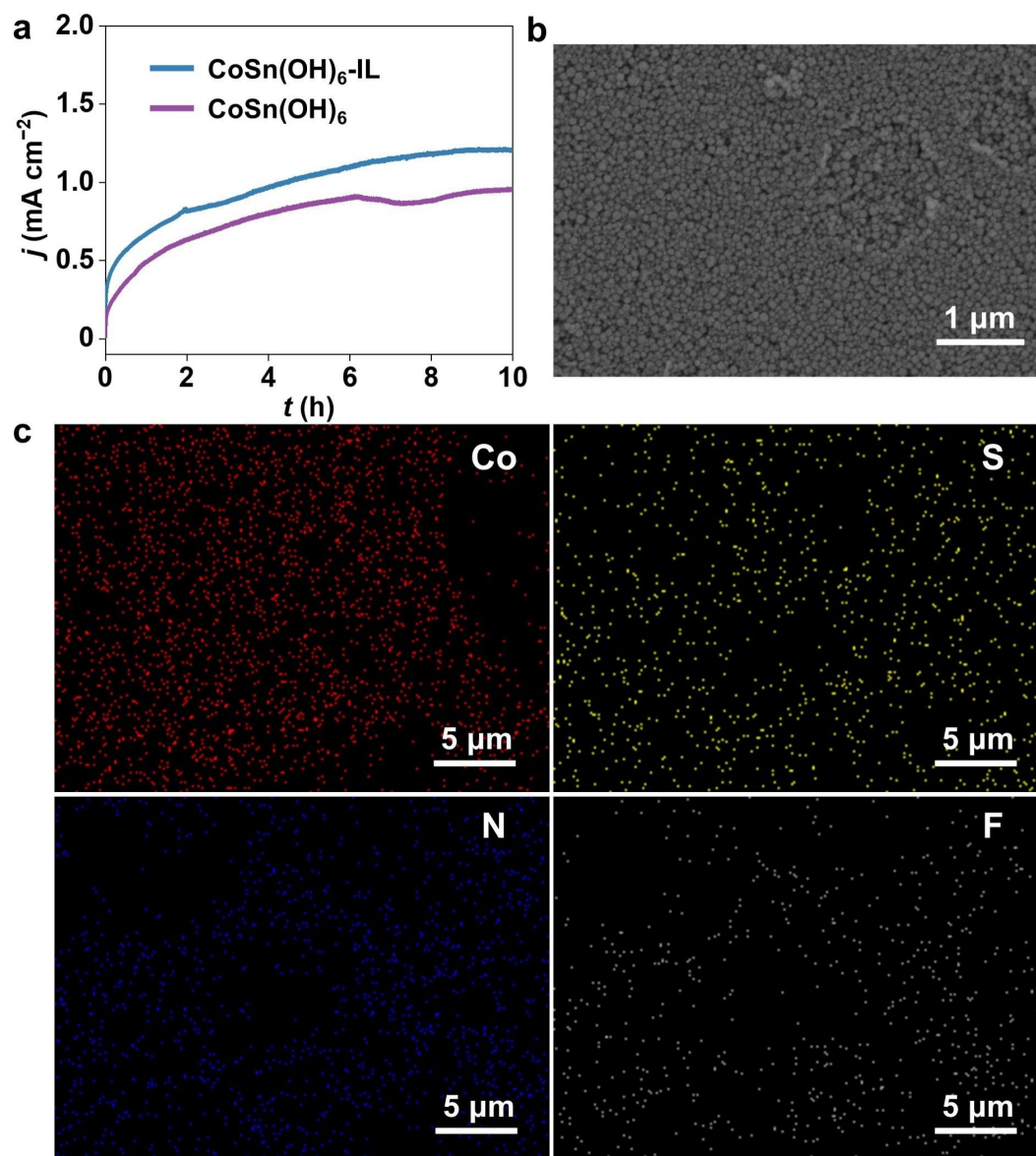


Figure S8 (a) Constant potential electrolysis at 1.85 V of CoSn(OH)₆ and CoSn(OH)₆-IL, the SEM image (b) and EDX mapping (c) of CoSn(OH)₆-IL after OER test.

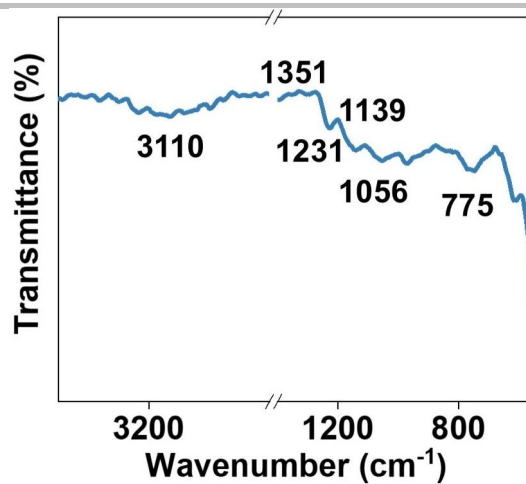


Figure S9 FTIR spectrum of CoSn(OH)₆-IL after OER test.

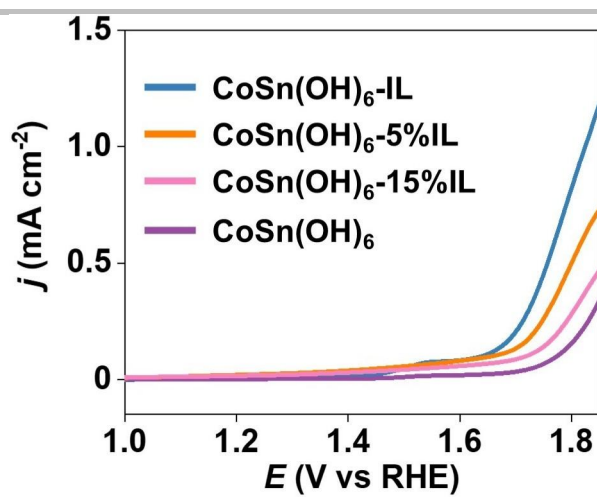


Figure S10 LSV plots of catalysts modified by the IL with different loadings.

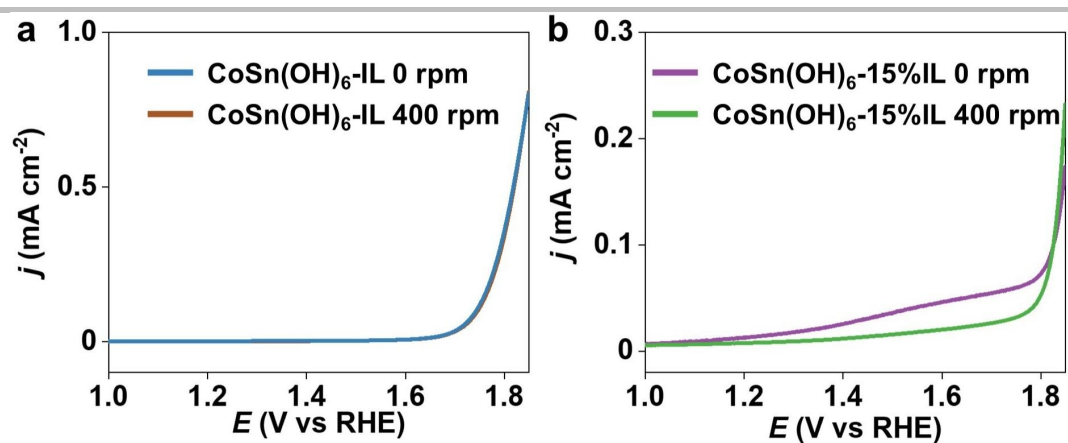


Figure S11 LSV plots of CoSn(OH)₆-IL (a) and CoSn(OH)₆-15%IL (b) at the rotation rate of 0 and 400 rpm.

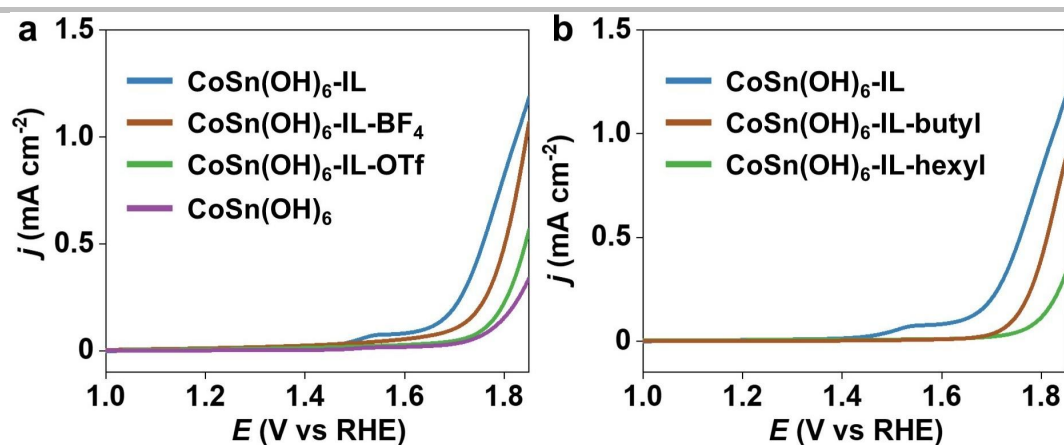


Figure S12 LSV plots of catalysts modified by the IL with different anions (a) and by the IL with different alkyl chain lengths (b).

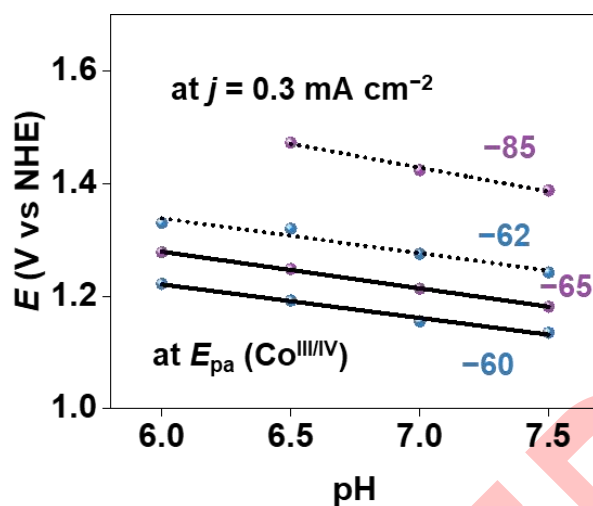


Figure S13 The voltage responses of CoSn(OH)₆ and CoSn(OH)₆-IL to the pH values of the electrolyte at $E_{pa}(\text{Co}^{III/IV})$ and the current density of 0.3 mA cm^{-2} .

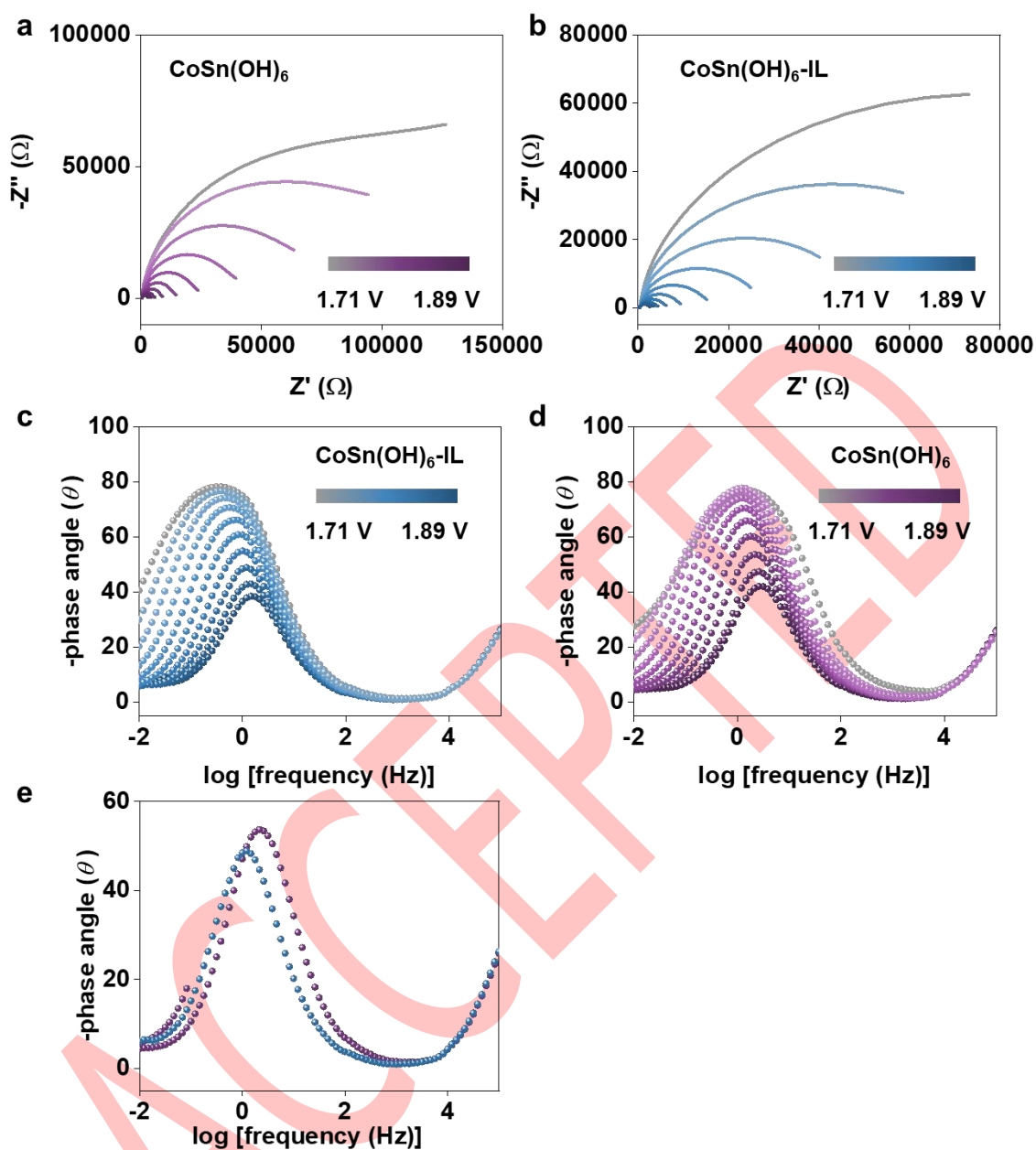


Figure S14 (a,b) Nyquist plots and (c,d) Bode plots of CoSn(OH)_6 and $\text{CoSn(OH)}_6\text{-IL}$ at different potentials, (e) Bode plots of the CoSn(OH)_6 and $\text{CoSn(OH)}_6\text{-IL}$ electrodes at 1.85 V.

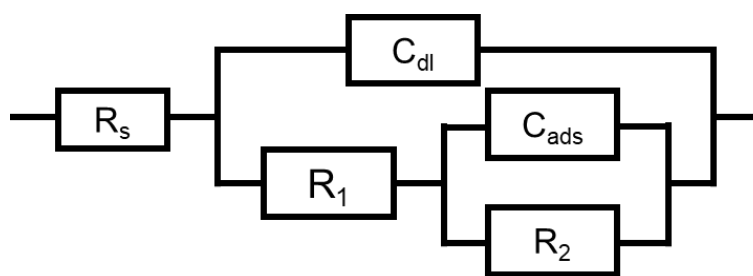


Figure S15 The equivalent electrical circuit to fit the EIS.

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Table S1 The mole fraction solubility of water in Tf₂N-based IL at 298.15 K [1].

IL	[C ₂ mim][Tf ₂ N]	[C ₄ mim][Tf ₂ N]	[C ₆ mim][Tf ₂ N]
mole fraction	0.2982 ± 0.0009	0.2568 ± 0.0006	0.2076 ± 0.0006

C₂mim, C₄mim, C₆mim represented 1-ethyl-3-methylimidazolium, 1-butyl-3-methylimidazolium, 1-hexyl-3-methylimidazolium, respectively.

- [1] Freire M G, Carvalho P J, Gardas R L, Marrucho I M, Santos L M N B F, Coutinho J A P. Mutual solubilities of water and the [C_nmim][Tf₂N] hydrophobic ionic liquids[J]. J. Phys. Chem. B, 2008, 112(6): 1604-1610.