

Electronic Supplementary Information (ESI)

Enhanced Electrocatalytic Reduction of Levulinic Acid to Value-Added Chemical Platforms

Pol Vilariño,^{a,b} Elvira Gómez^{a,b} and Albert Serra^{a,b,*}

^a *Grup d'Electrodeposició de Capes Primes i Nanoestructures (GE-CPN), Departament de Ciència de Materials i Química Física, Universitat de Barcelona, Martí i Franquès, 1, E-08028, Barcelona, Catalonia, Spain.*

^b *Institute of Nanoscience and Nanotechnology (IN2UB), Universitat de Barcelona, Barcelona, Catalonia, Spain.*

Corresponding author: a.serra@ub.edu

Electrodeposition of Copper

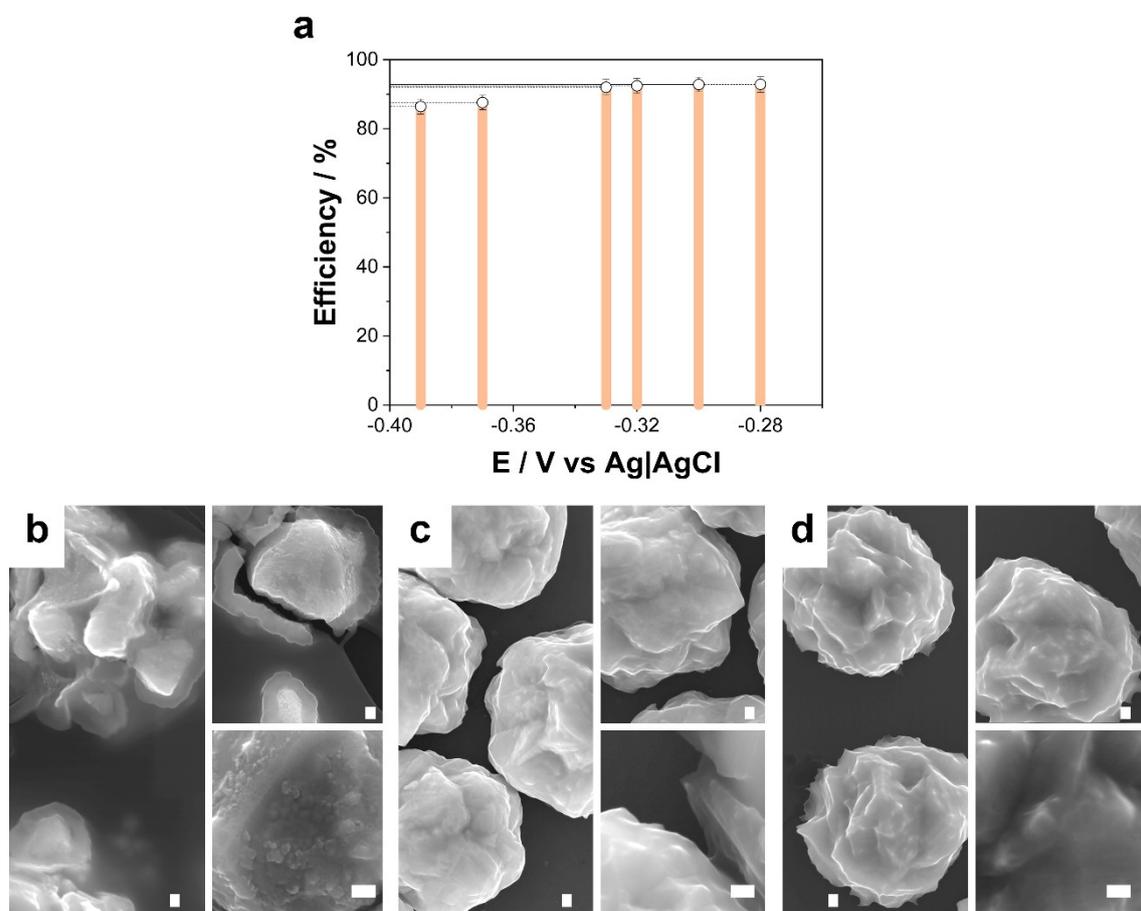


Figure S1: (a) Faradaic efficiency of copper electrodeposition as a function of applied potential. FE-SEM micrographs of copper deposits on the GC electrode obtained at (b) -0.30 V, (c) -0.39 V, and (d) -0.40 V vs. Ag|AgCl|Cl⁻. Scale bar: 200 nm.

Electrodeposition of Nickel

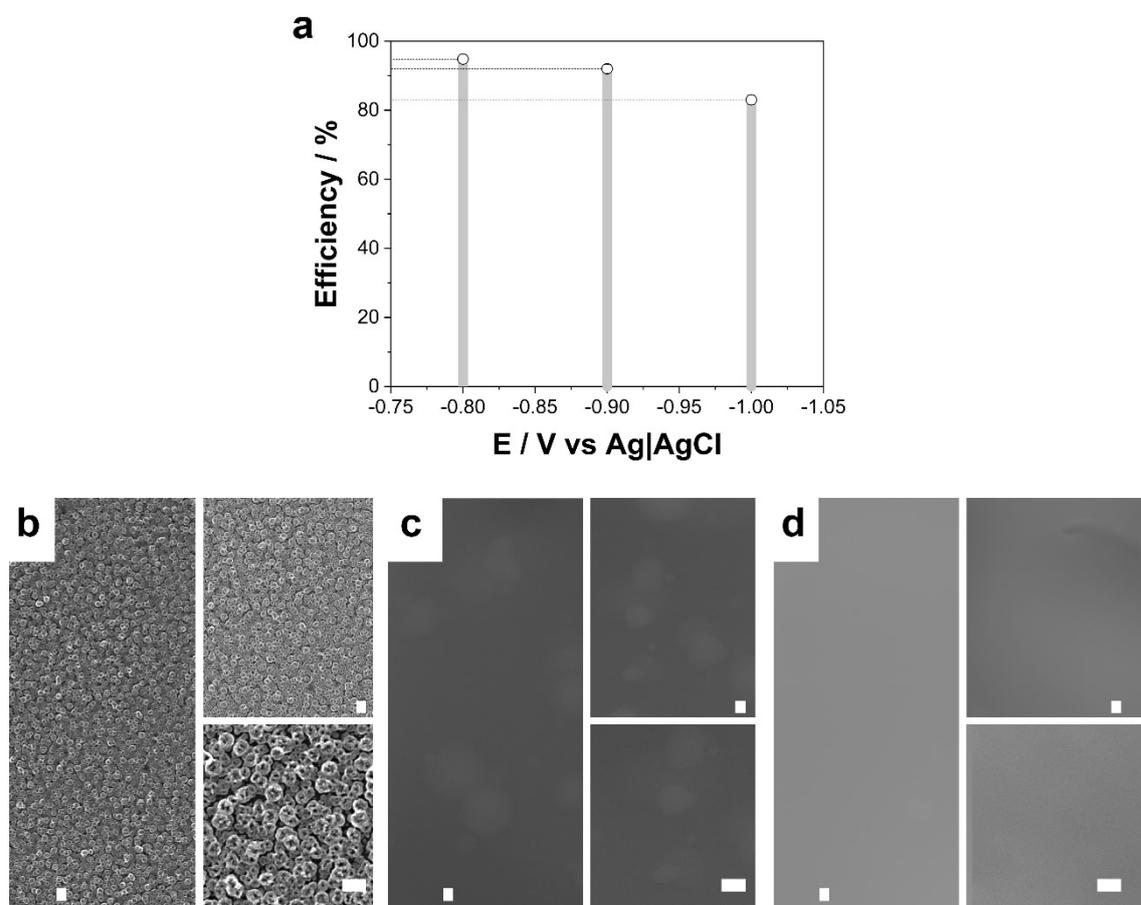


Figure S2: (a) Faradaic efficiency of nickel electrodeposition as a function of applied potential. FE-SEM micrographs of nickel deposits on the GC electrode obtained at (b) -0.90 V, (e) -1.00 V, and (f) -1.20 V vs. Ag|AgCl|Cl⁻. Scale bar: 200 nm.

Electrodeposition of Ruthenium

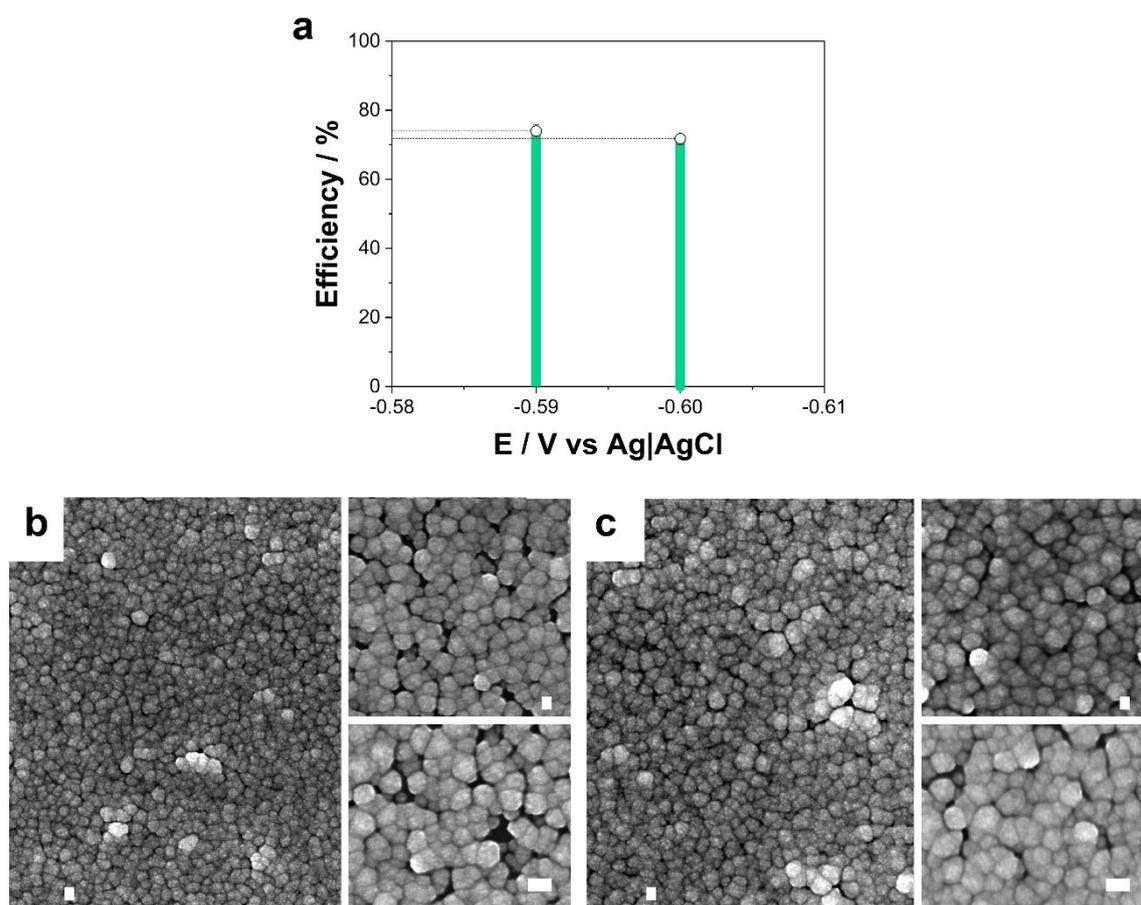


Figure S3: (a) Faradaic efficiency of ruthenium electrodeposition as a function of applied potential. FE-SEM micrographs of ruthenium deposits on the GC electrode obtained at (c) -0.59 V, and (d) -0.60 V vs. Ag|AgCl|Cl⁻. Scale bar: 200 nm.

Network for the Electrochemical Hydrogenation (ECH) of Levulinic Acid

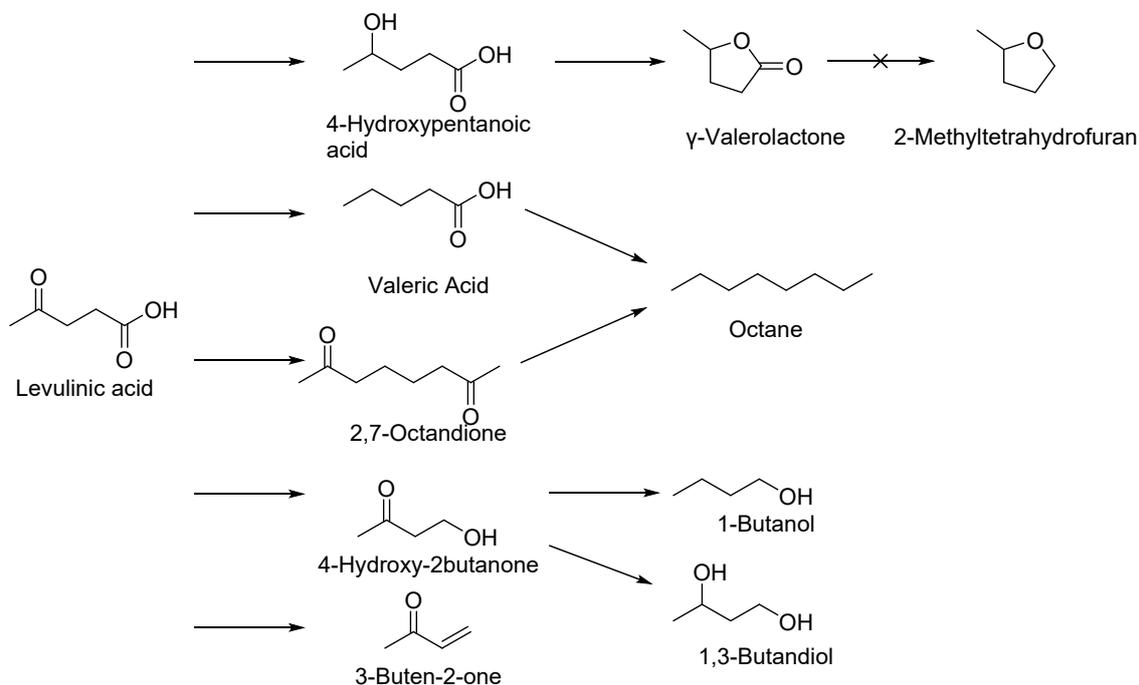


Figure S4. Proposed reaction network for the electrochemical hydrogenation (ECH) of levulinic acid (LA), including key intermediates such as 4-hydroxypentanoic acid, valeric acid, 2,7-octanedione, 4-hydroxy-2-butanone, and their respective transformation into value-added C4 and C8 products (e.g., GVL, octane, 1-butanol, 1,3-butandiol).

Proposed electrochemical reaction pathway for the hydrogenation of levulinic acid (LA) to γ -valerolactone (GVL) and valeric acid (VA) in alkaline media

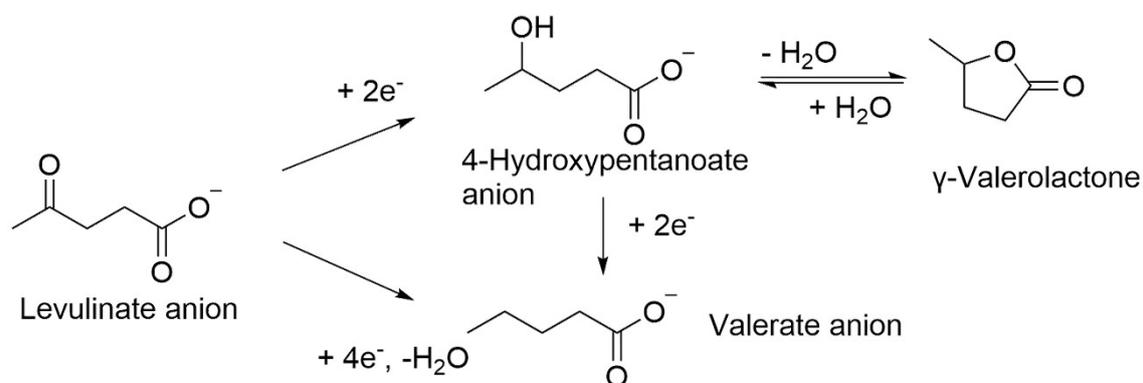


Figure S5: Proposed electrochemical reaction pathway for the hydrogenation of levulinic acid (LA) to γ -valerolactone (GVL) and valeric acid (VA) in alkaline media.

Electrodeposition of Copper-Nickel

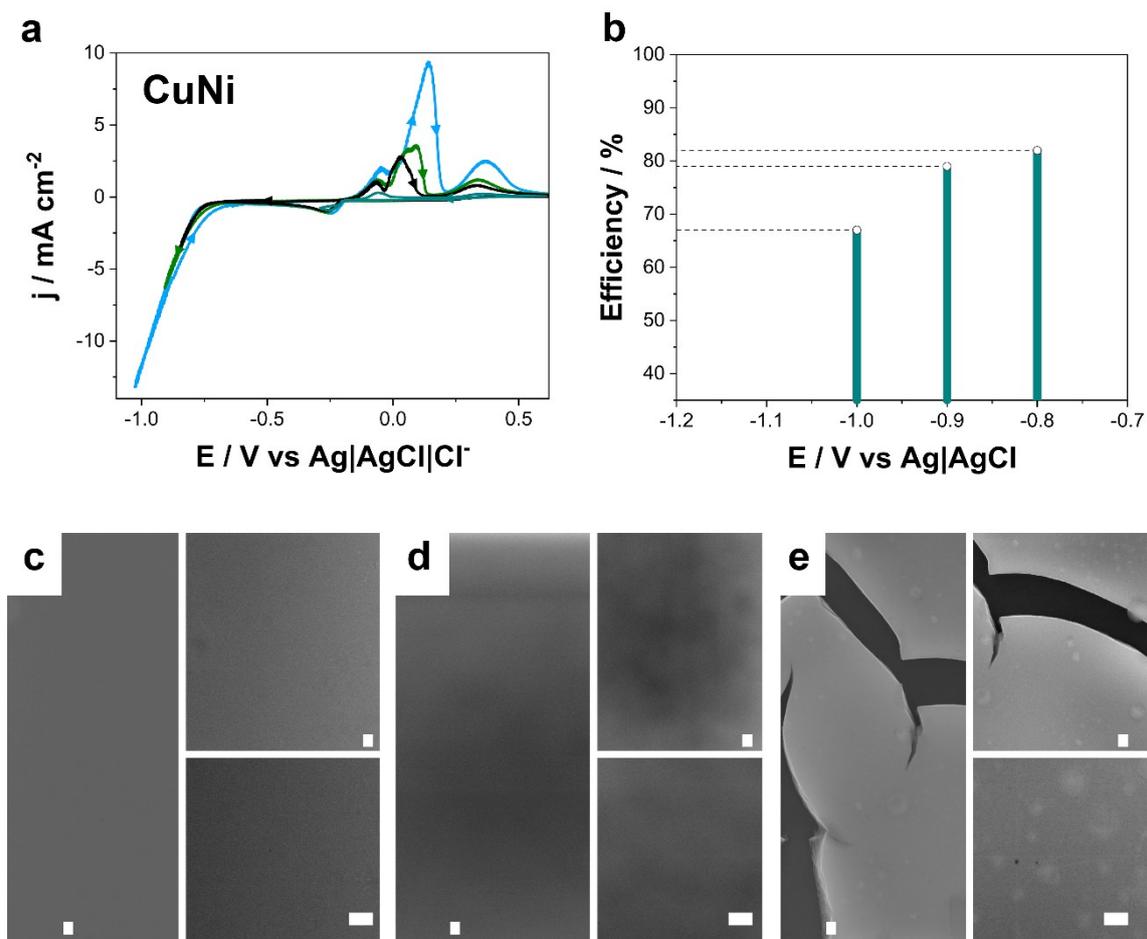


Figure S6: (a) Cyclic voltammograms (CV) recorded at various potential limits in a CuNi solution on a GC electrode, with a scan rate of 50 mV s^{-1} at $25 \text{ }^\circ\text{C}$. (b) Faradaic efficiency of copper-nickel electrodeposition as a function of applied potential. FE-SEM micrographs of copper-nickel deposits on the GC electrode obtained at (c) -0.80 V, (d) -0.90 V, and (e) -1.00 V vs. Ag|AgCl|Cl⁻. Scale bar: 200 nm.

Electrodeposition of Copper-Ruthenium

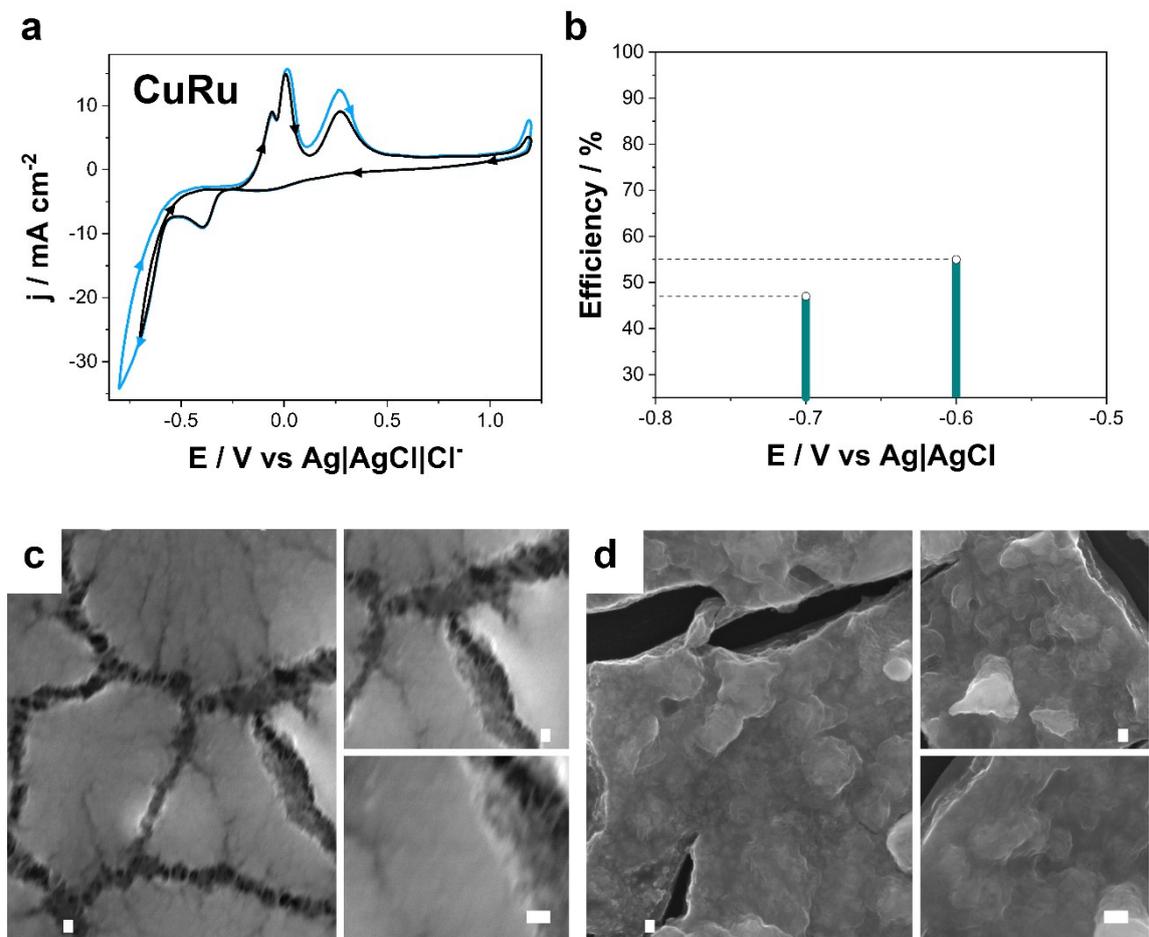


Figure S7: (a) Cyclic voltammograms (CV) recorded at various potential limits in a CuRu solution on a GC electrode, with a scan rate of 50 mV s⁻¹ at 25 °C. (b) Faradaic efficiency of copper-ruthenium electrodeposition as a function of applied potential. FE-SEM micrographs of copper-ruthenium deposits on the GC electrode obtained at (c) -0.60 V, and (d) -0.70 V vs. Ag|AgCl|Cl⁻. Scale bar: 200 nm.

Electrodeposition of Nickel-Ruthenium

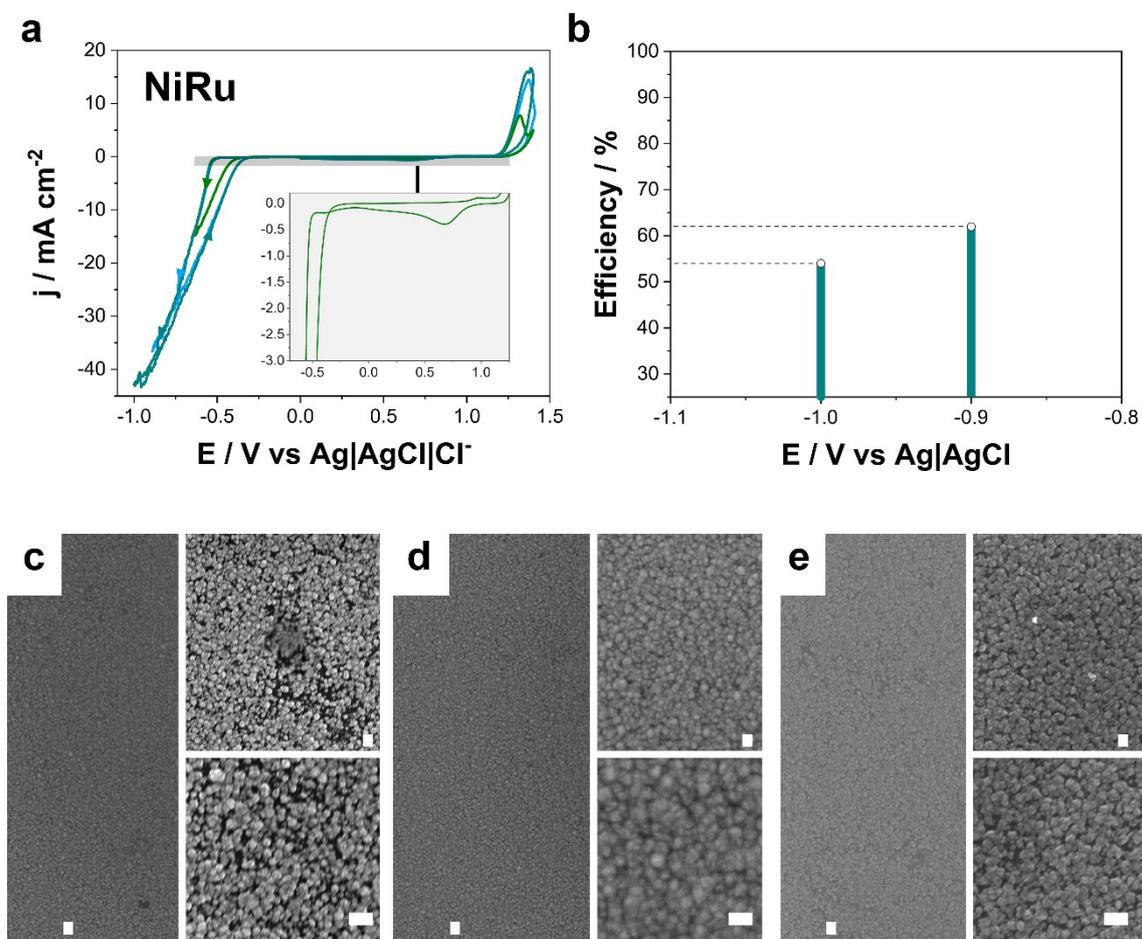


Figure S8: (a) Cyclic voltammograms (CV) recorded at various potential limits in a NiRu solution on a GC electrode, with a scan rate of 50 mV s^{-1} at $25 \text{ }^\circ\text{C}$. (b) Faradaic efficiency of nickel-ruthenium electrodeposition as a function of applied potential. FE-SEM micrographs of nickel-ruthenium deposits on the GC electrode obtained at (c) -0.80 V , (d) -0.90 V , and (e) -1.00 V vs. Ag|AgCl|Cl⁻. Scale bar: 200 nm.

Electrodeposition of Copper-Nickel-Ruthenium

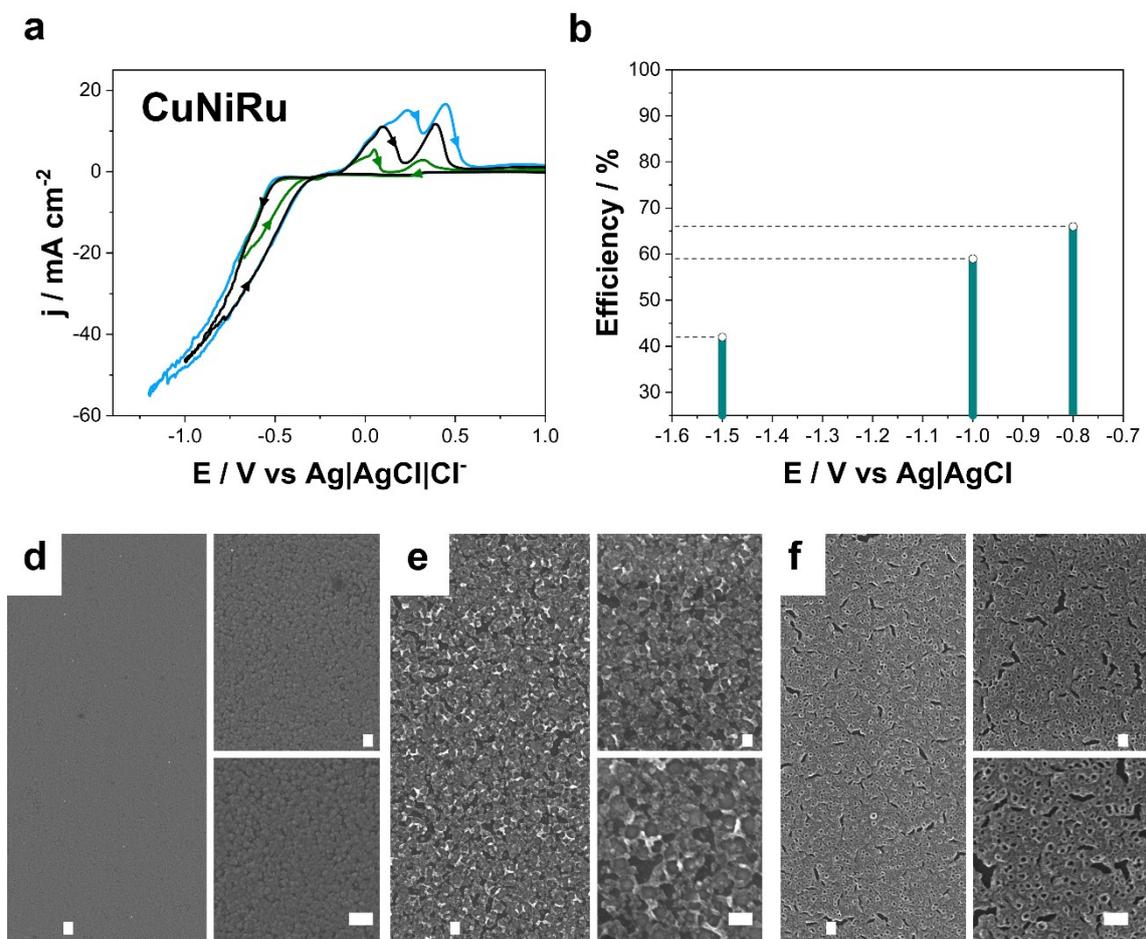


Figure S9: (a) Cyclic voltammograms (CV) recorded at various potential limits in a CuNiRu solution on a GC electrode, with a scan rate of 50 mV s⁻¹ at 25 °C. (b) Faradaic efficiency of copper-nickel-ruthenium electrodeposition as a function of applied potential. FE-SEM micrographs of copper-nickel-ruthenium deposits on the GC electrode obtained at (c) -0.80 V, (d) -1.00 V, and (e) -1.50 V vs. Ag|AgCl|Cl⁻. Scale bar: 200 nm.