

Table S1. The Weight of Cathodes before and after the Electrowinning Process

Copper concentration	100 mM coated electrode	500 mM coated electrode
1 g Cu/L solution (1.5 L) = 1.5 g of Cu in total	1.96 g	1.96 g
10 g Cu/L solution (1.5 L) = 15 g of Cu in total	15.71 g	16.18 g

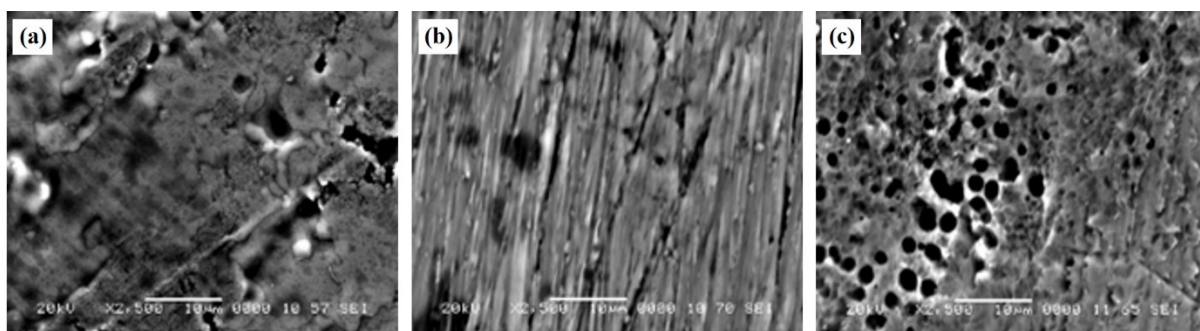


Fig. S1. SEM images of (a) bared, (b) scrubbed, and (c) etched Ti substrate.

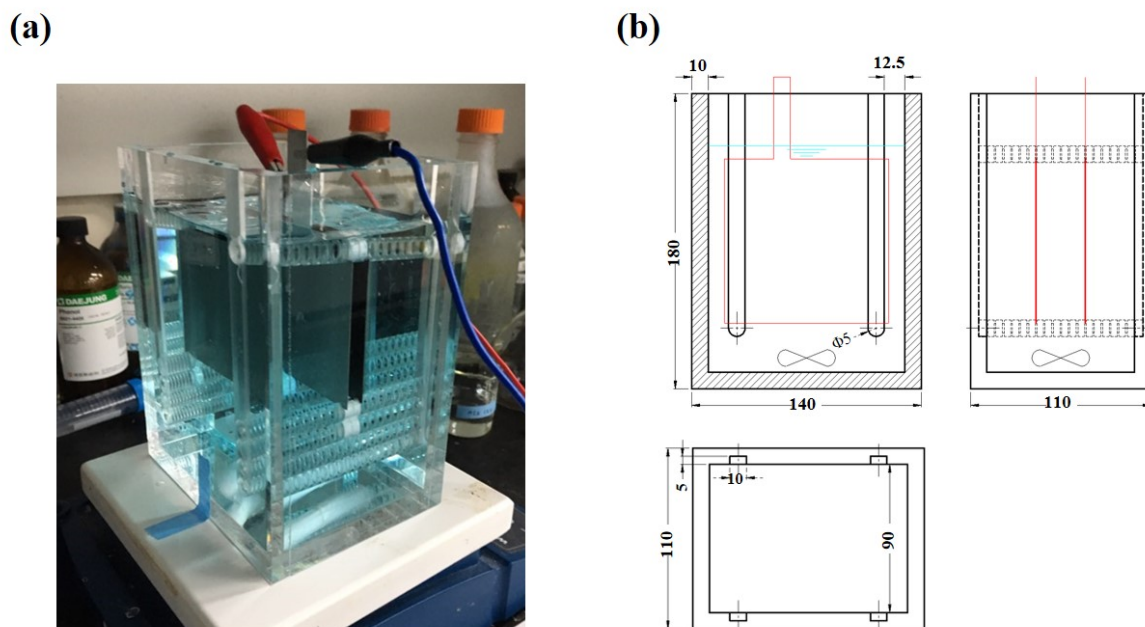


Fig. S2. (a) Photography of batch reactor for electrowinning process and (b) its specific blueprint.

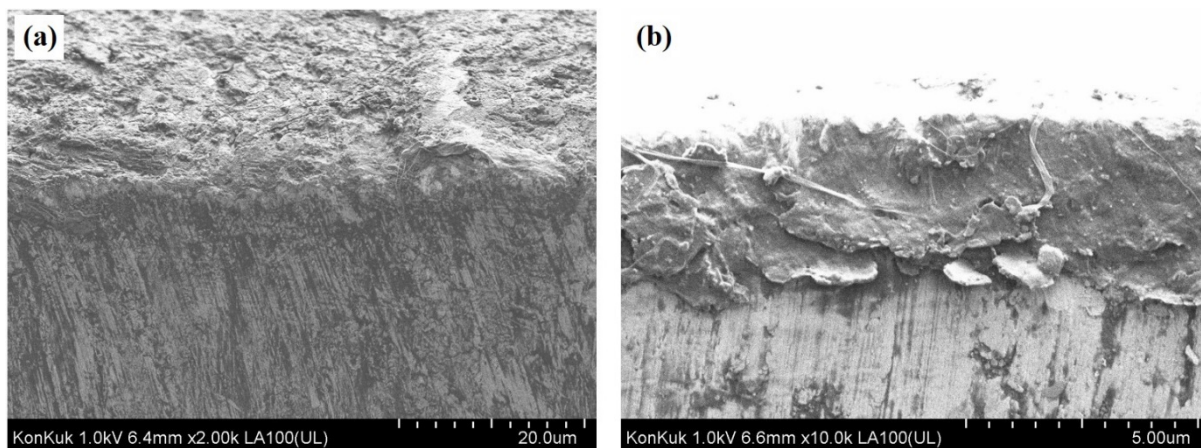


Fig. S3. FE-SEM images of cross sectional area for the Ti/Ir-Ru anodes coated with (a) 100 and (b) 500 mM precursor solutions.

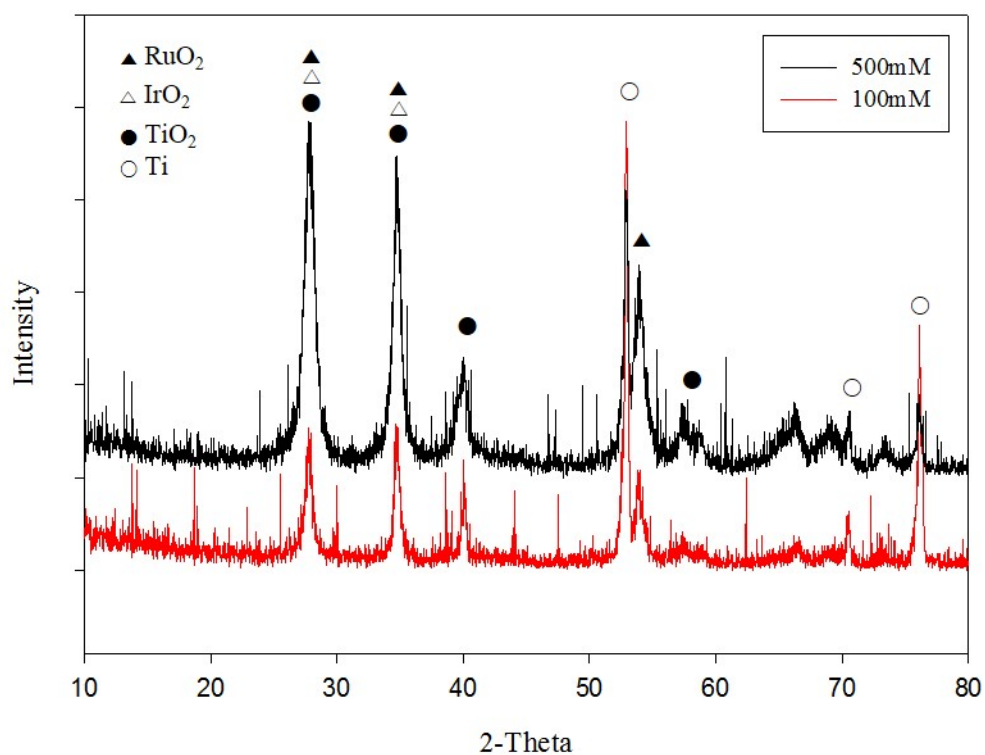


Fig. S4. XRD patterns of the Ti/Ir-Ru anodes coated with 100 and 500 mM precursor solutions.

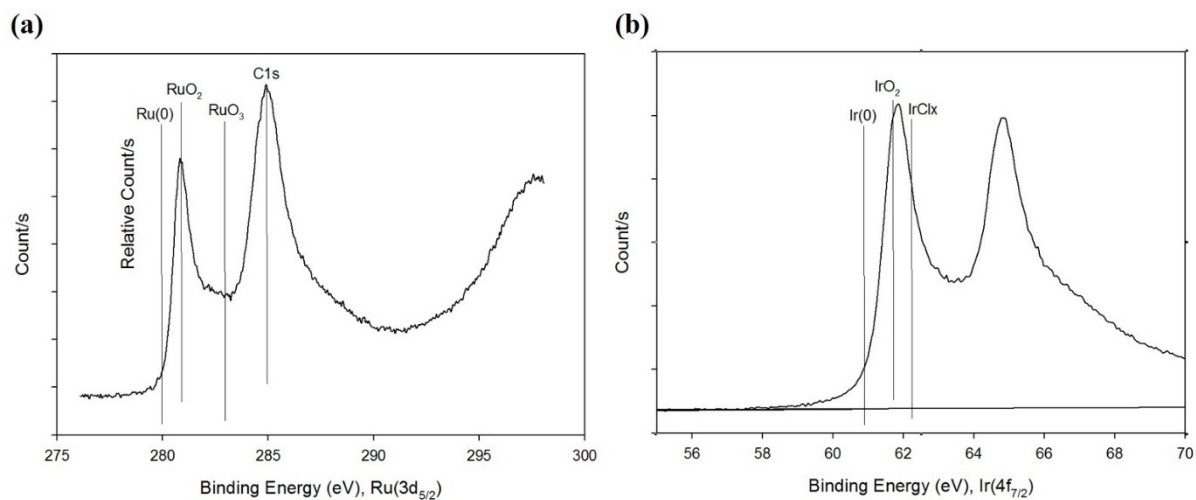


Fig. S5. XPS spectra showing the range of (a) Ru ($3p_{5/2}$) and (b) Ir ($4f_{7/2}$) for the Ti/Ir-Ru anodes coated with 100 and 500 mM precursor solutions.

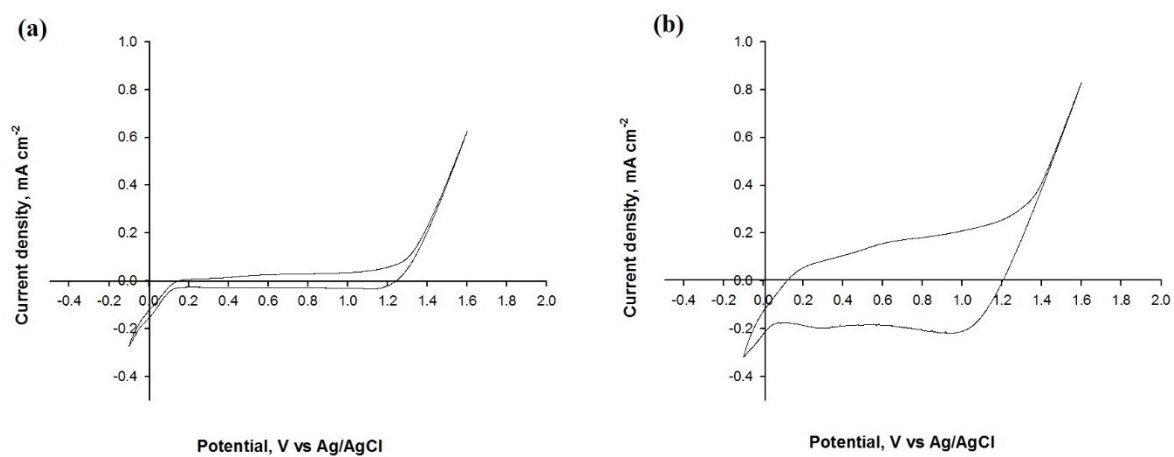


Fig. S6. Cyclic voltammograms for the Ti/Ir-Ru anodes coated with (a) 100 and (b) 500 mM precursor solutions.