nanomaterials

MDPI

Supplementary Materials

Efficient Electrocatalyst Nanoparticles from Upcycled Class II Capacitors

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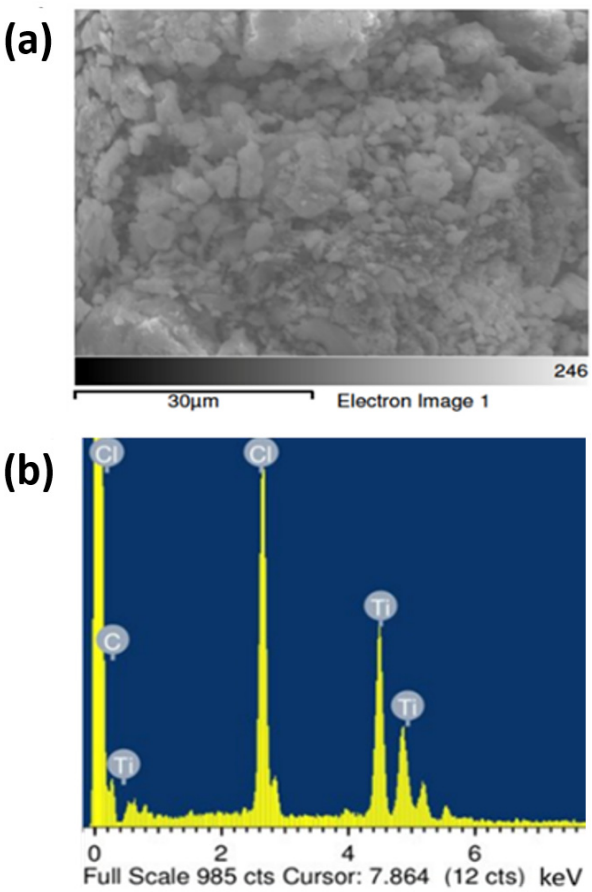

Figure S1. (**a**) The SEM image captured from the residual of leaching MLCC; (**b**) Energy dispersive X-ray (EDX) elemental analysis of the residual of leaching MLCC.

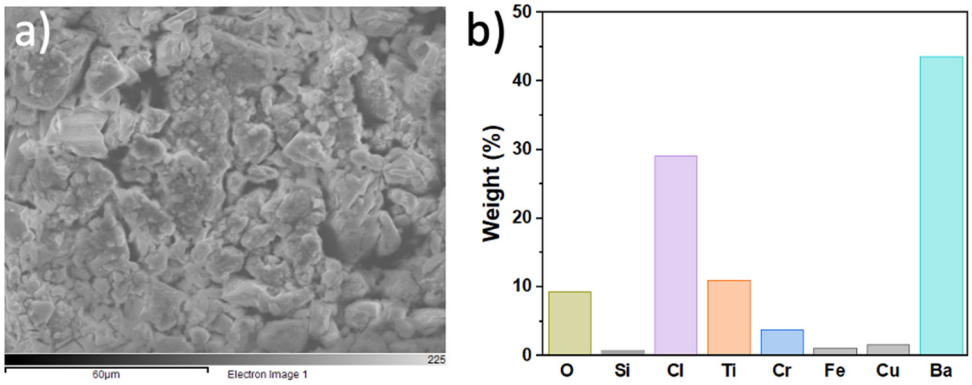

Figure S2. (**a**) SEM and (**b**) Energy dispersive X-ray (EDX) elemental analysis of the residual after MLCC leaching and extraction using the Aliquat® 336-HCl-H_2O system.

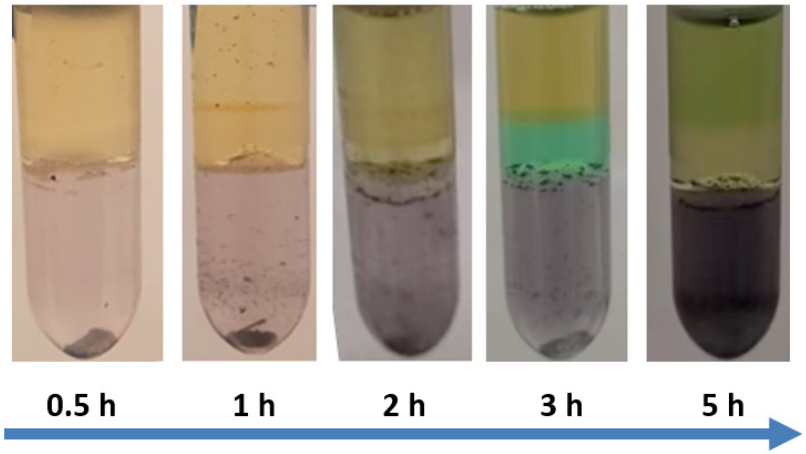

Figure S3. Tube appearance evolution as a function of time during the MLCC combined leaching and extraction process (one MLCC placed in 1 mL of 6 M HCl and 1 mL Aliquat® 336 agitated at 1000 rotations per minute (rpm) for 5h at 60°C, using the *Eppendorf ThermoMixer C* equipment).

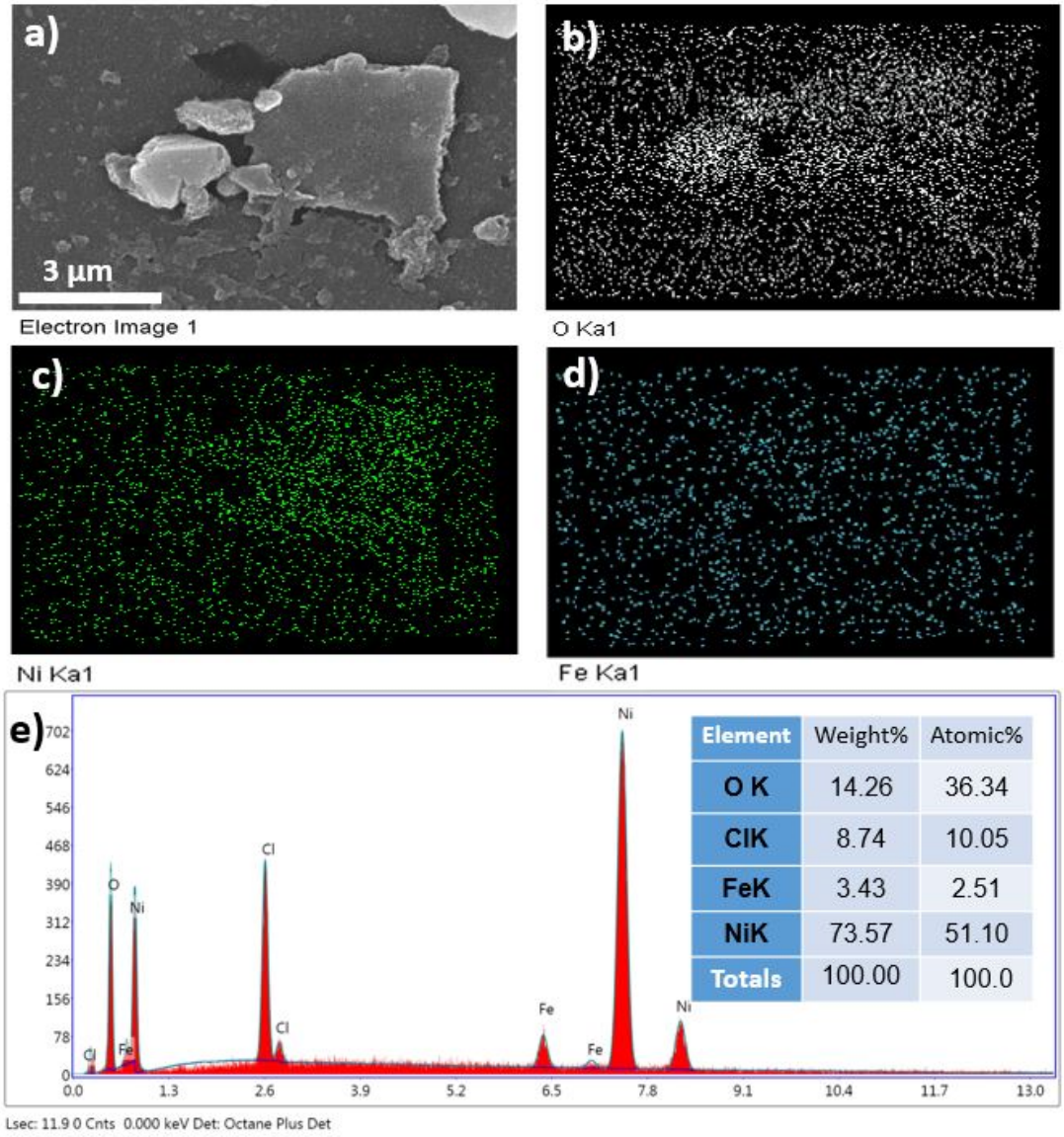

Figure S4. (**a**) SEM image of amorphous NiFe-hydroxide catalyst; (**b**), (**c**) and (**d**) the corresponding SEM-EDX element distribution images for O, Ni, and Fe. (**e**) The element composition of NiFe-hydroxide catalyst.

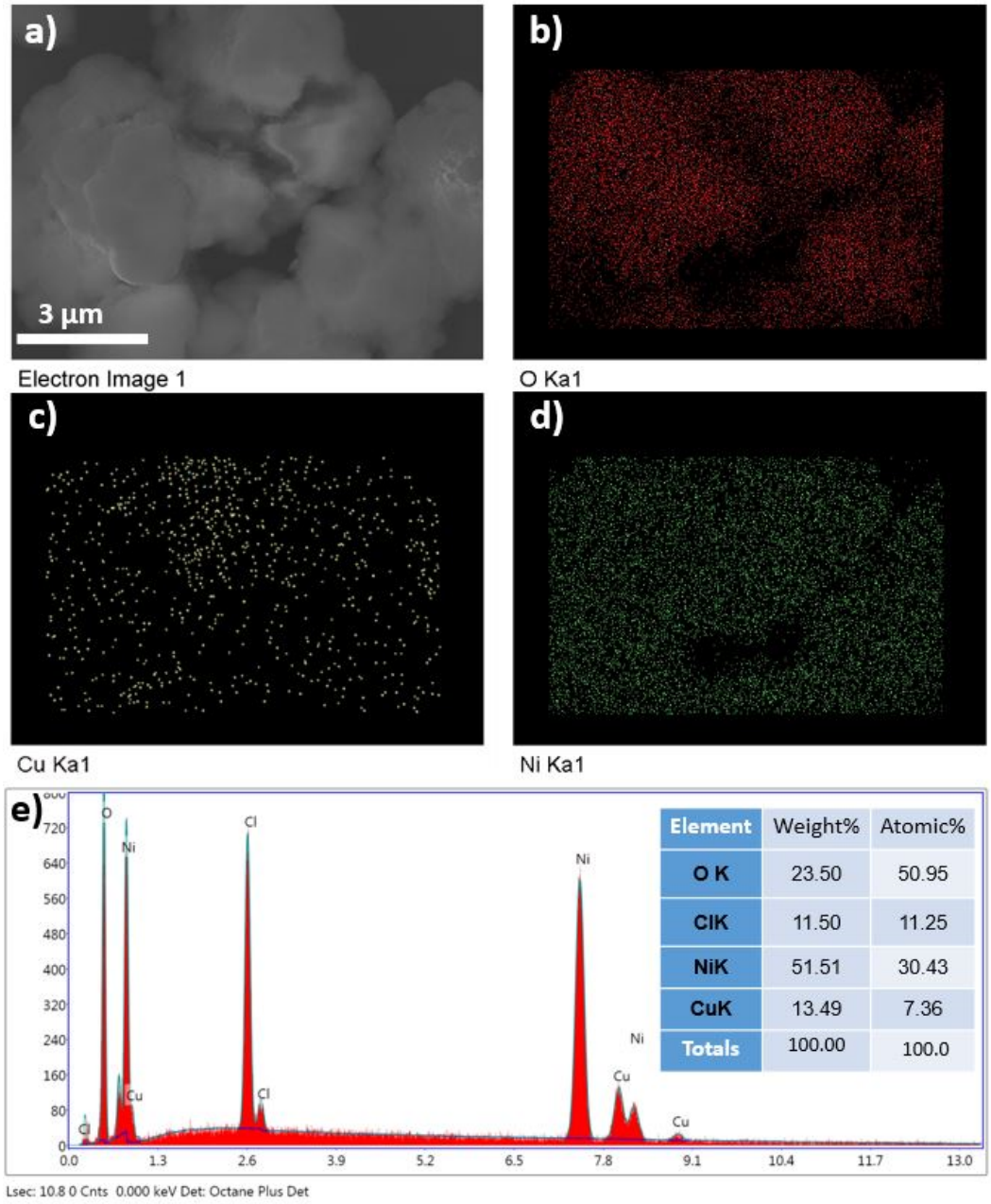

Figure S5. (**a**) SEM image of NiCu-hydroxide catalyst. (**b**), (**c**) and (**d**) the corresponding SEM-EDX element distribution images for O, Cu and Ni. (**e**) The element composition of NiCu-hydroxide catalyst.

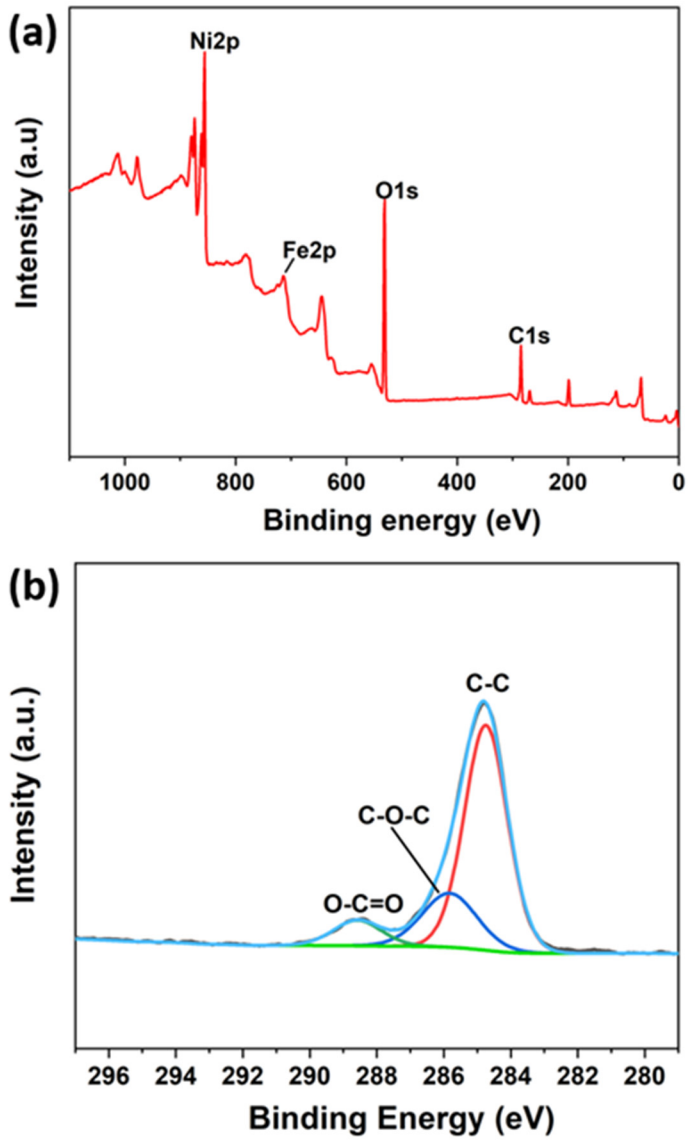

Figure S6. XPS spectra for NiFe-hydroxide: (a) full spectra; (b) C 1s peak deconvolution.

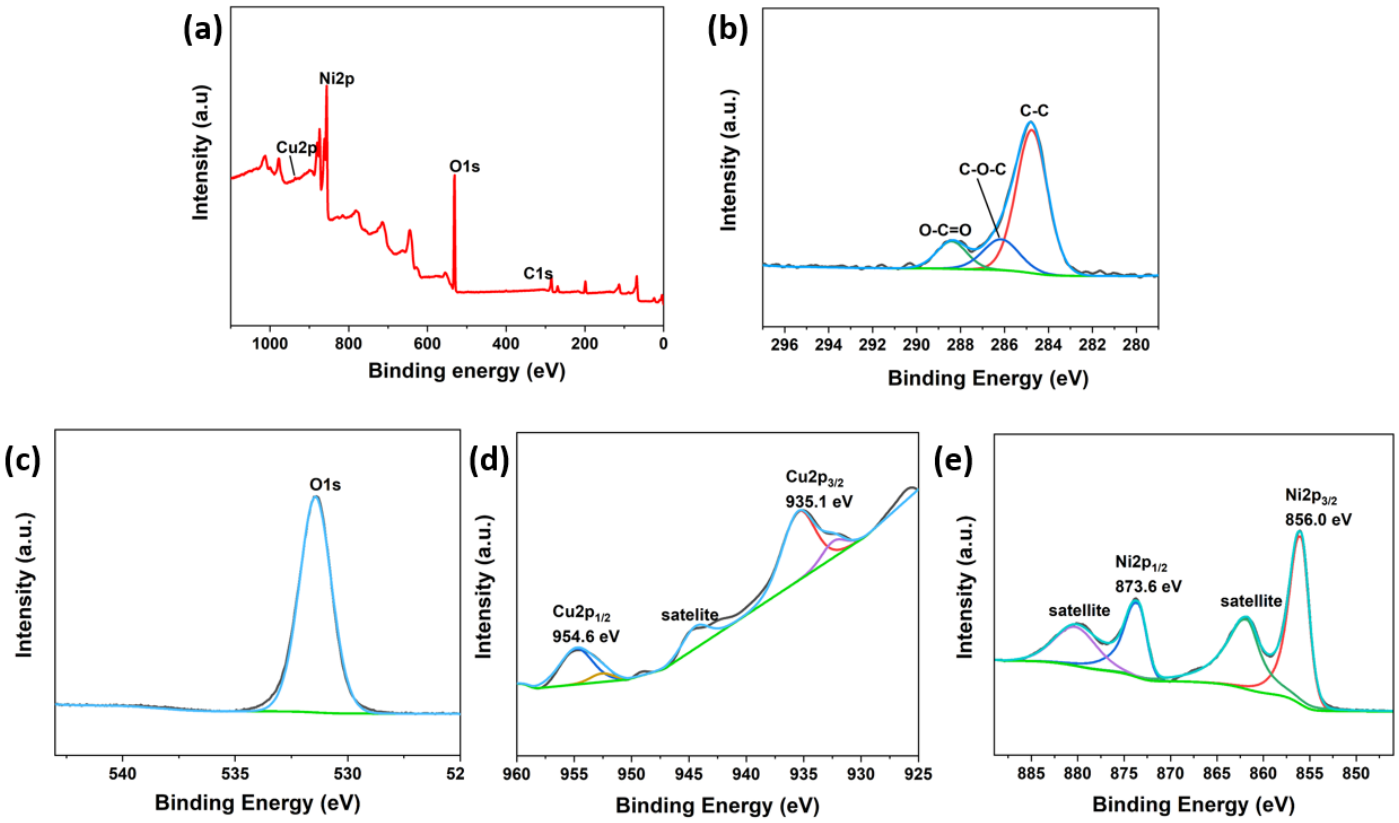

Figure S7. XPS spectra of NiCu-hydroxide: (**a**) full spectra, and various peaks deconvolution (**b**) C 1s, (**c**) O 1s, (**d**) Cu 2p and (**e**) Ni 2p.

Table S1. Metals analysis of scrubbed and regenerated ionic liquid from Zone 3 and zone 4.

		Scrub Agent		**Regenerate Agent**	
	6 M NaOH	6 M NaOH	6 M NaOH	0.5 M HCl	0.5 M HCl
Al	-	-	-	-	-
Ni	-	-	-	-	-
Zn	-	-	-	-	-
Co	-	-	-	-	-
Mn	-	-	-	-	-
Cu	57.3	6.4	-	-	-
Fe	-	-	-	-	-
Pb	-	-	-	-	-
Ti	-	-	-	-	-
Sn	350.1	272.2	76.8	-	-

Table S2. Metals analysis of Pb selective precipitation from the Ni, Fe and Pb and Ni, Cu, Pb HCl back-extraction solutions from Zone 3 (stream 1) and Zone 4 (stream 2).

Solution	**Metals**	**Original Solution (mg/L)**	**Solution After Precipitation (mg/L)**	**Solution Dissolved the Precipitation Solid by 1 M H_2SO_4 (mg/L)**
Stream 1	Fe	31.1	-	153.1
	Ni	697.3	-	3408.5
	Pb	169.1	37.37	-
Stream 2	Cu	69.7	-	350.5
	Ni	792.2	-	3892.9
	Pb	221.1	69.33	-