Electronic Supplementary Information for

Efficient and Stable Iodine doped Nickel-Hydroxide Electrocatalyst for Water Oxidation: Synthesis, Electrochemical Performance and Stability

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Materials and methods

All the chemicals used during synthesis to applications prospects were of analytical grade and utilized as such as received. The P-XRD analysis was carried out using Lab XRD-6100. The FTIR analysis was done using IRAffinity-1s. The FESEM analysis was carried out on ZEISS LEO SUPRA 55 and EDX was done by JEOL JCM-6000Plus SEM. The BET analysis was done on Micromeritics ASAP 2020 physisorption analyzer. The electrochemical measurements were done using Gamry 5000E potentiostat using three electrode system. Ag/AgCl as a reference electrode,

Pt wire as a counter electrode. One molar aqueous solution of KOH was used as an electrolyte. All the potentials taken vs Ag/AgCl were converted to RHE potentials using equation.

$$E_{RHE} = E_{Ag/AgCl} + 0.059\ pH + {}^{0}E_{Ag/AgCl}$$

Synthesis of electrocatalysts

The iodine doped $Ni(OH)_2$ was synthesized by one step hydrothermal method. In this process, 0.2 M nickel nitrate hexahydrate and KI solutions were mixed in an appropriate ratio. The mixture was stirred under constant stirring and 0.2 M NaOH aqueous solution was added to it dropwise till precipitation starts. After this, the mixture was continuously stirred for 2 hours and incubated in autoclave for 24 hours at 160 ℃. After the completion of incubation period, the precipitates were washed with distilled water and dried at 60℃. The resultant product was called as I; $Ni(OH)_2$. Similar method was also adopted for the synthesis of pure $Ni(OH)_2$. The prepared pure $Ni(OH)_2$ was mixed with 16 mg alcoholic solution of pure iodine in pestle mortar and called as I_2: $Ni(OH)_2$.

Preparation of electrode material

A measured piece of carbon fiber cloth (CFC) was taken and washed with ethanol, acetone and then with distilled water. The 15 mg of catalysts powder was taken in glass vial and 100 μL of distilled water was added. The mixture was sonicated for 2 hours and 10 μL of catalysts ink was drop casted on 1 cm^2 selected area of CFC.

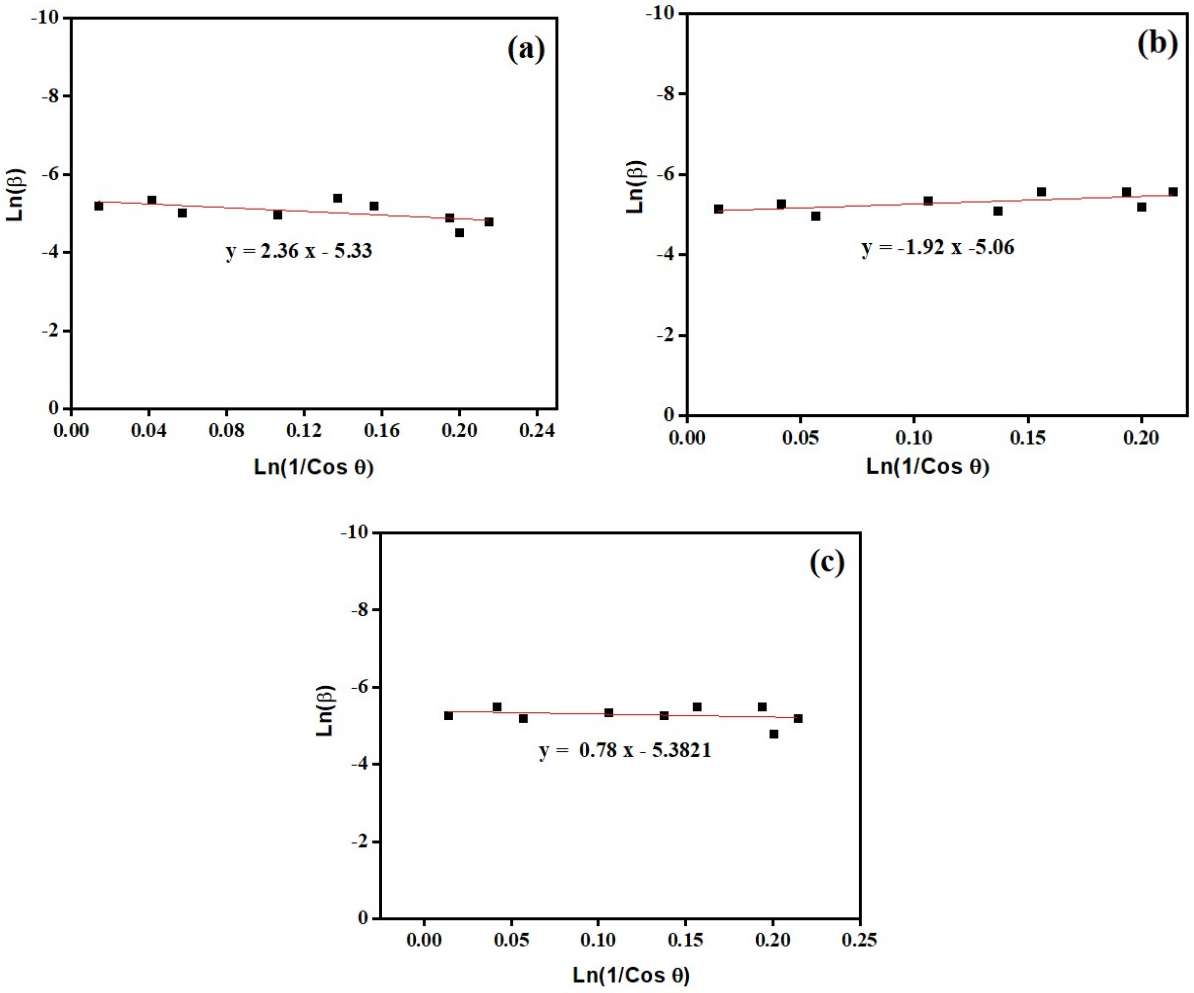

Figure S1: *Sherer plot of a) $Ni(OH)_2$, b) Iodine doped Ni(OH)2 and c) Iodine loaded Ni(OH)2 electrocatalysts.*

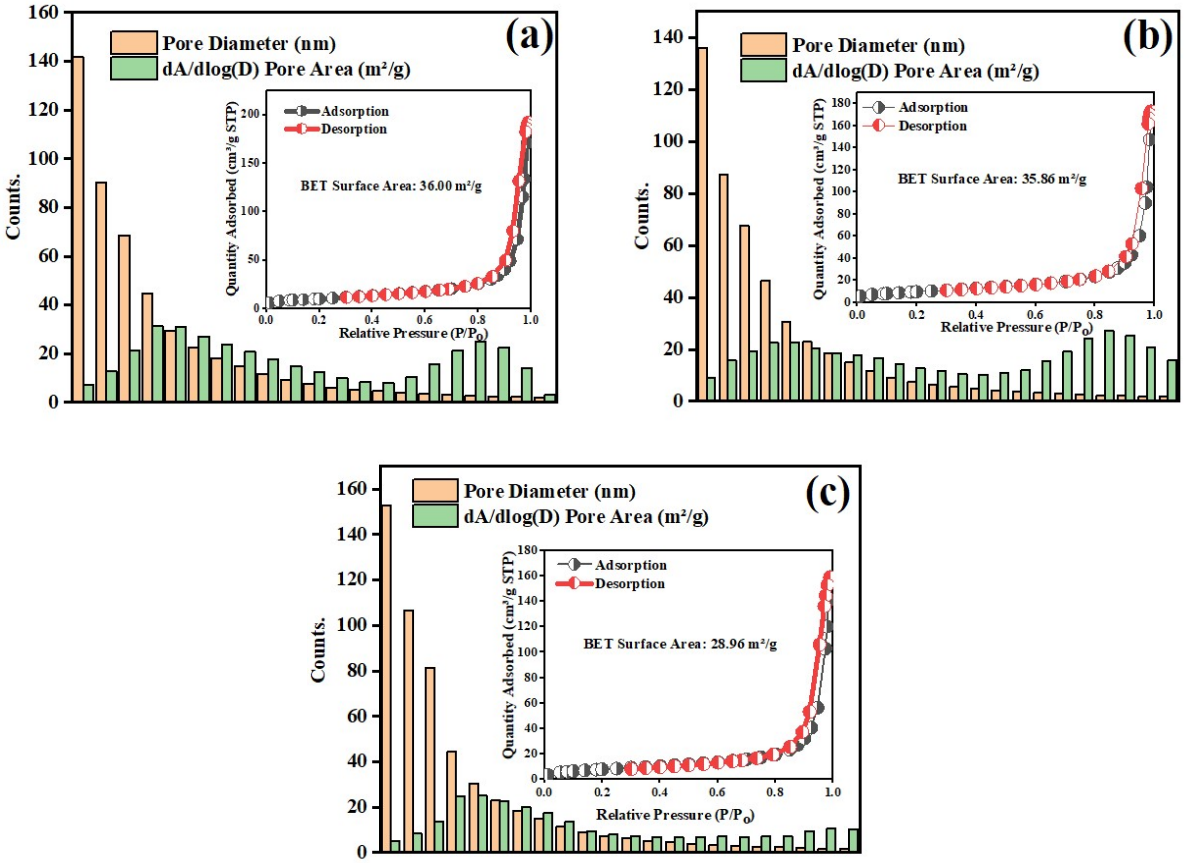

Figure S2: *Bar-graph showing pore diameter and pore area of a) $Ni(OH)_2$, b) Iodine doped Ni(OH)2 and c) Iodine loaded Ni(OH)2 electrocatalysts and inset shows their relative BET plots.*

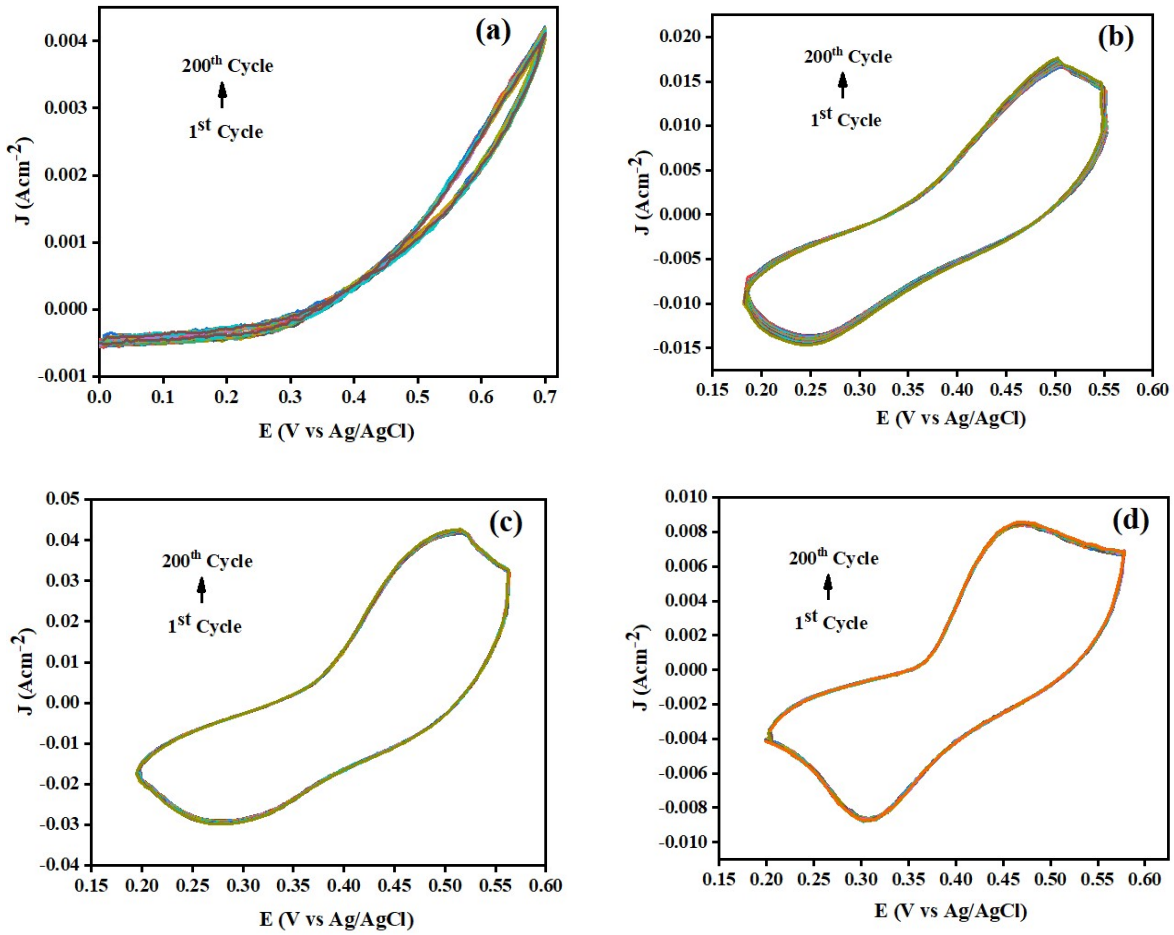

Figure S3: *Cyclic voltammogram representing for 1st, 10th, 20th, and up to 200th cycles for a) $Ni(OH)_2$, b) Iodine doped Ni(OH)2 and c) Iodine loaded Ni(OH)2 electrocatalysts.*

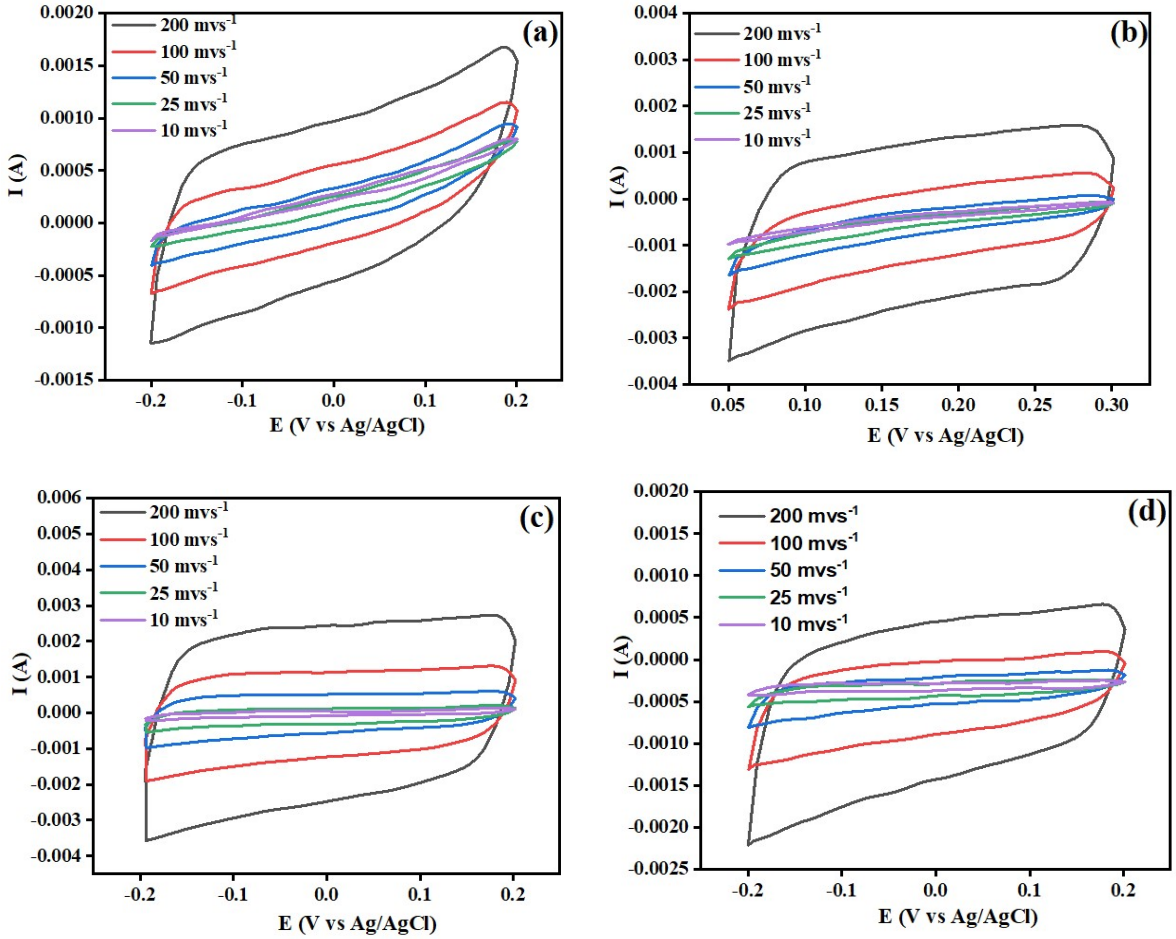

Figure S4: *Cyclic voltammogram for calculation of electrochemical active surface area for a) $Ni(OH)_2$, b) Iodine doped Ni(OH)2 and c) Iodine loaded Ni(OH)2 electrocatalysts.*

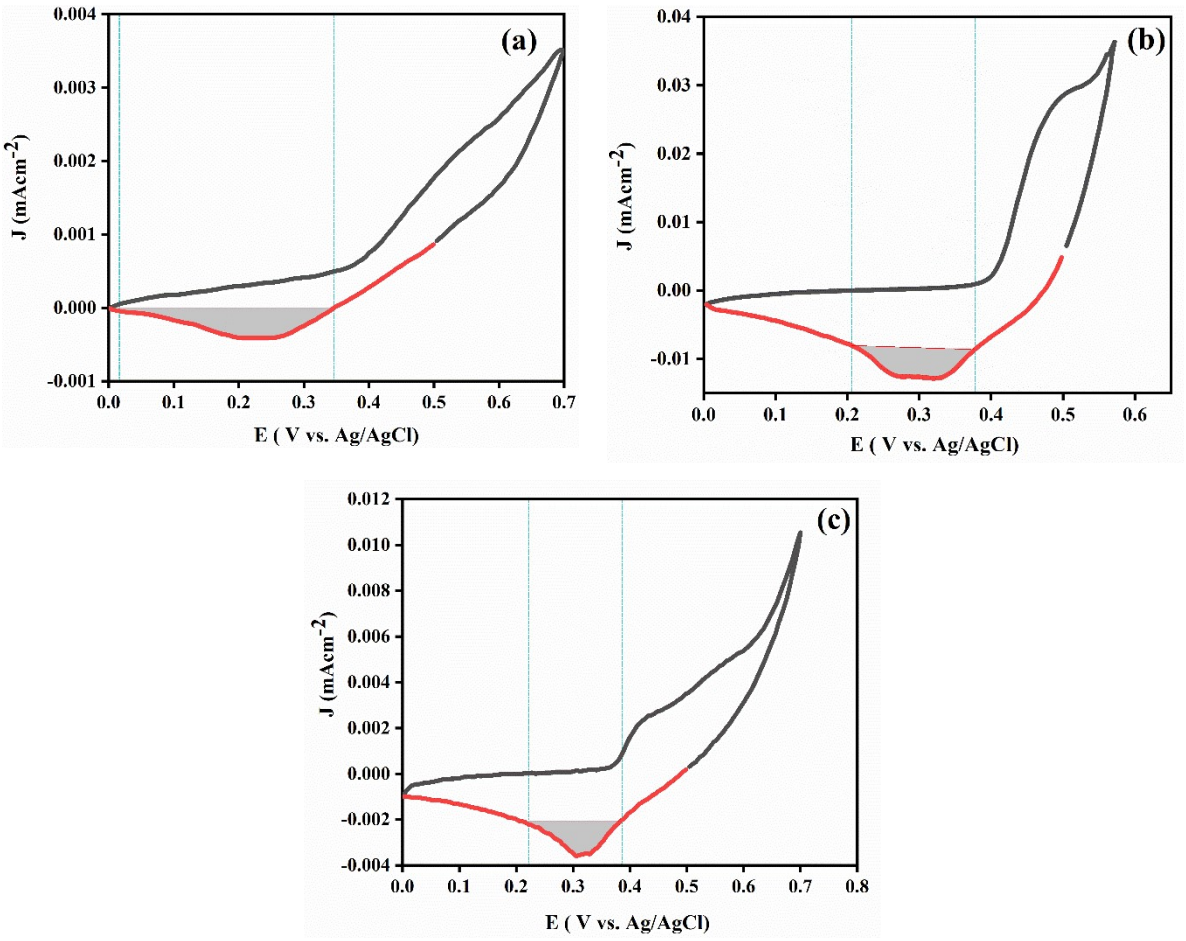

Figure S5: *CV curve showing area under reduction peak for a) $Ni(OH)_2$, b) Iodine doped Ni(OH)2 and c) Iodine loaded Ni(OH)2 electrocatalysts.*

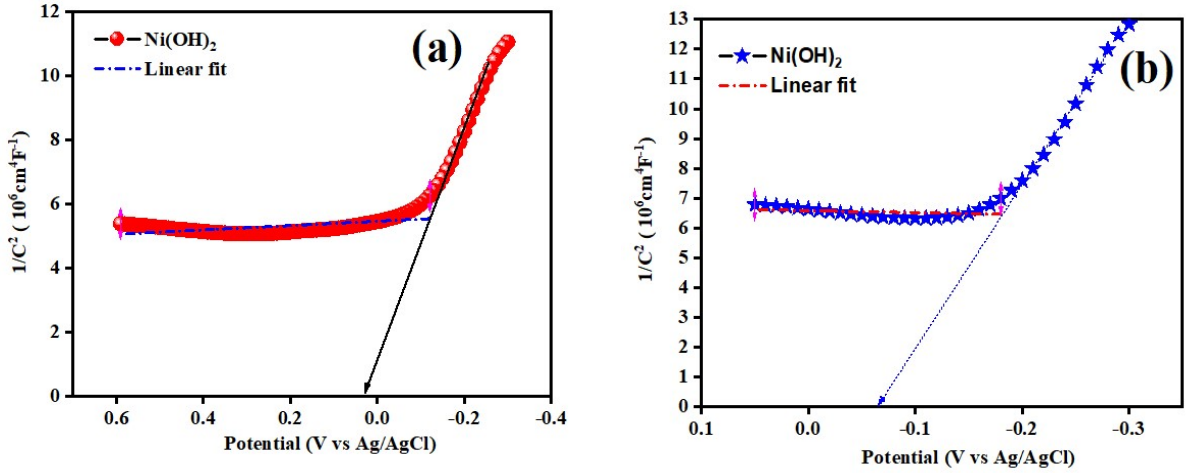

Figure S6: *Mott-Schottky plots of the a) $Ni(OH)_2$ and b) I- $Ni(OH)_2$.*

Table S1: *FTIR and Mott-Schottky results of $Ni(OH)_2$, Iodine doped Ni(OH)2 and Iodine loaded Ni(OH)2 electrocatalysts.*

S. N	Material	FTIR Vibrations(cm^{-1})			Flat band potential	Carrier density
		O-H	Ni-O-Ni	Ni-O	(V)	($\times 10^{31} cm^{-3}$)
1	$Ni(OH)_2$	3635	483	426	0.03	9.82
2	I: $Ni(OH)_2$	3635	494	432	-0.064	10.2
3	I_2: $Ni(OH)_2$	3635	498	430	--	--