

## Supporting information

### A porous Co<sub>3</sub>Mo<sub>3</sub>N/N-doped carbon electrocatalyst derived from Mo-Co MOF for electrochemical hydrogen evolution reaction

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### Electrochemical characterization towards HER:

All of the electrochemical measurements were conducted in 3 electrode using 1 M alkaline electrolyte solution at room temperature, Ag/AgCl used as reference and graphite rod as counter. All potentials vs Ag/AgCl was calibrated into reversible hydrogen electrode (RHE) based on standard Nernst equation followed by,  $E_{RHE} = E_{Ag/AgCl} + 0.059\text{pH} + E^{\circ}_{Ag/AgCl}$ . The LSV of fabricated electrodes were performed at the potential ranges 0 to -0.6 V vs RHE at the 2 mV/s. From this, overpotential values was estimated by using the formula,  $\eta = E_{RHE} - 0$  at minimum current density value of 10 mA/cm<sup>2</sup>. Additionally, intrinsic characteristics of the prepared catalyst were analysed by Tafel slope analysis by plotting a linear fit of log of current density (in mA cm<sup>-2</sup>) in X axis and overpotential at Y axis as per the equation of  $\eta = a + b \log j$ , where  $\eta$  - overpotential value,  $j$  denotes current density and  $b$  is Tafel slope. The measurement was conducted by taking steady state chronoamperometry test for 100 seconds at different potentials.

The cyclic voltammetry analysis of the fabricated electrodes was performed with 0.9 to 1.0 V vs RHE at various scan rates of 10 to 100 mV/s. From this CV curves, double layer capacitance ( $C_{dl}$ ) values was measured by the formula of  $C_{dl} = |j_a - j_c|/2$  at different scan rates

and the respective electrochemical active surface area (ECSA) was estimated by formula  $ECSA = C_{dl}/C_s$ , where  $C_s$  be specific capacitance of used substrate was taken as  $40 \text{ mF cm}^{-2}$ .

The electrochemical impedance spectroscopy (EIS) analysis was executed at frequency window of 10 mHz to 100 kHz with the amplitude of 5 mV. Also, the Zsimpwin software was employed to fit analysed EIS results. The chronoamperometry test (time vs current) of the prepared electrodes were analysed at low  $10 \text{ mA cm}^{-2}$  for prolong duration of 20 h. The polarization curves was analysed at  $10 \text{ A/cm}^2$  and compared with before and after the stability test.

**Table S1** Comparison table of overpotential, Tafel slope values of  $\text{Co}_3\text{Mo}_3\text{N/NC}$  electrocatalyst with previous literatures

Catalyst	Overpotential $\eta$ (mV)	Tafel slope value (mV/dec)	Current density (mA/cm <sup>2</sup> )	Electrolyte solution	Ref
Cobalt-molybdenum carbide@graphitic carbon nanocomposites	165	130.3			104
MOF derived Molybdenum Carbide/Nitride	119	54			105
Co/CoN/Co <sub>2</sub> P-NPC	99	51	10	KOH	106
NC/Ni <sub>3</sub> Mo <sub>3</sub> N/NF	44.6	41.50			107
MoNiS/Mo <sub>2</sub> TiC <sub>2</sub> T <sub>x</sub> catalyst	153	92			108
Co/WN@NC	143	90			109
Co-Mo-P@C	159	131			110
<b>Co<sub>3</sub>Mo<sub>3</sub>N/NC</b>	<b>125</b>	<b>98.49</b>			<b>This work</b>