

Supporting Information

**0D/2D Heterojunctions of Molybdenum Carbide-Tungsten Carbide
Quantum Dots/N-Doped Graphene Nanosheets as Superior and
Durable Electrocatalysts for Hydrogen Evolution Reaction**

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Table S1. Target and actual Mo/W molar ratios as assessed by EDS and ICP and crystalline phases in different $(\text{Mo}_2\text{C})_x\text{-(WC)}_{1-x}\text{-QDs/N G}$ electrocatalysts.

Catalysts	Target molar ratio of Mo/W	Actual molar ratio of Mo/W (ICP)	Actual molar ratio of Mo/W (EDS)	Crystalline phase
$\text{Mo}_2\text{C-QDs/NG}$	1:0	1:0	1:0	Mo_2C
$(\text{Mo}_2\text{C})_{0.41}\text{-(WC)}_{0.18}\text{-QDs/NG}$	0.75:0.25	0.82:0.18	0.78:0.22	$\text{Mo}_2\text{C} + \text{WMoC}$
$(\text{Mo}_2\text{C})_{0.34}\text{-(WC)}_{0.32}\text{-QDs/NG}$	0.50:0.50	0.68:0.32	0.65:0.35	$\text{Mo}_2\text{C} + \text{WMoC}$
$(\text{Mo}_2\text{C})_{0.24}\text{-(WC)}_{0.52}\text{-QDs/NG}$	0.25:0.75	0.48:0.52	0.43:0.56	$\text{Mo}_2\text{C} + \text{WMoC} + \text{WC}$
WC-QDs/NG	0:1	0:1	0:1	WC

Table S2. The BET and BJH properties of $(\text{Mo}_2\text{C})_x\text{-(WC)}_{1-x}\text{-QDs/N G}$ electrocatalysts with different molar ratios.

Catalysts	$S_{\text{BET}} / \text{m}^2 \text{g}^{-1}$	Pore Volume / $\text{cm}^3 \text{g}^{-1}$	Pore Size / nm
$\text{Mo}_2\text{C-QDs/NG}$	296	0.36	3.65
$(\text{Mo}_2\text{C})_{0.41}\text{-(WC)}_{0.18}\text{-QDs/NG}$	278	0.35	3.53
$(\text{Mo}_2\text{C})_{0.34}\text{-(WC)}_{0.32}\text{-QDs/NG}$	281	0.36	3.56
$(\text{Mo}_2\text{C})_{0.24}\text{-(WC)}_{0.52}\text{-QDs/NG}$	272	0.34	3.65
WC-QDs/NG	269	0.35	3.55

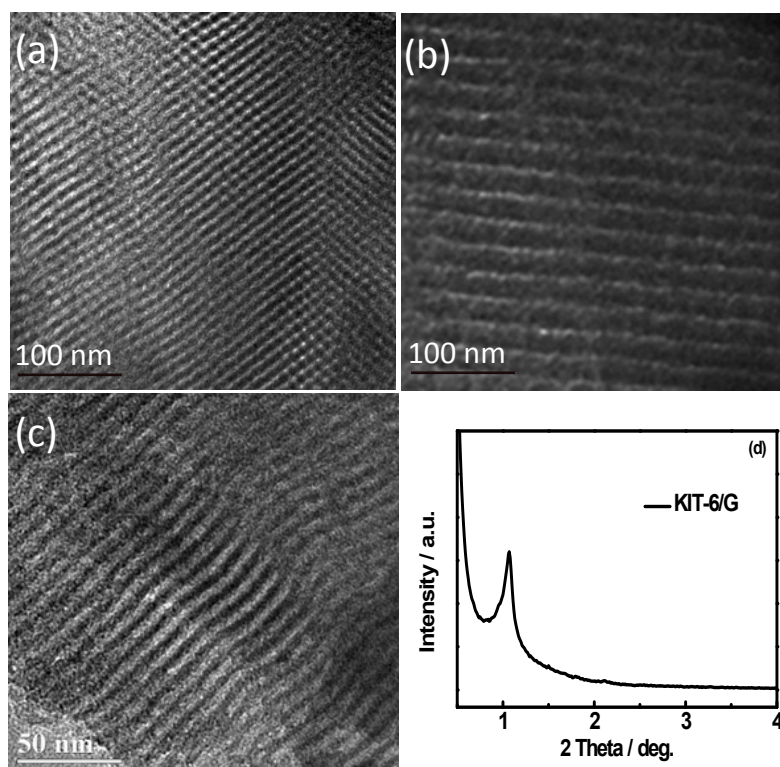


Figure S1. (a, b and c) TEM images and (c) SAXRD pattern of KIT-6/G template

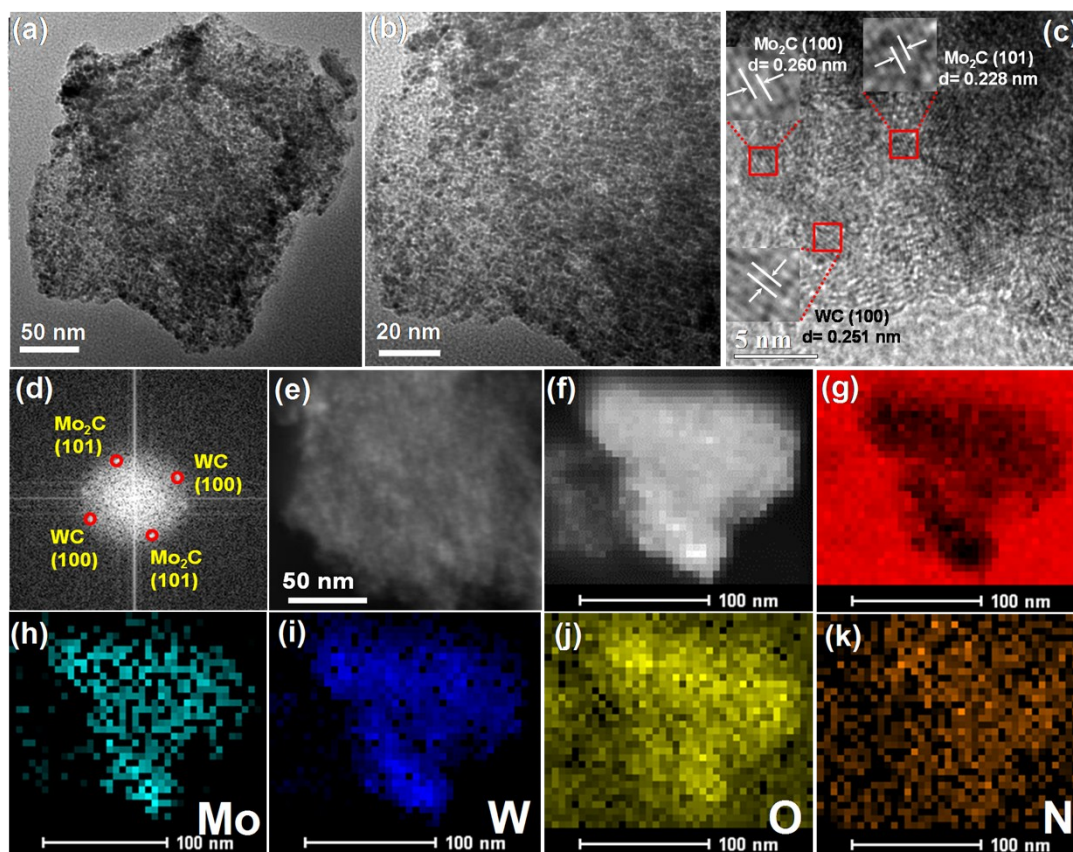


Figure S2. (a and b) TEM images, (c) HRTEM image, (d) the fast Fourier transform (FFT) image, (e and f) STEM images and (g-k) elemental mapping images of $(\text{Mo}_2\text{C})_{0.41}-(\text{WC})_{0.18}\text{C}/\text{NG}$ electrocatalyst.

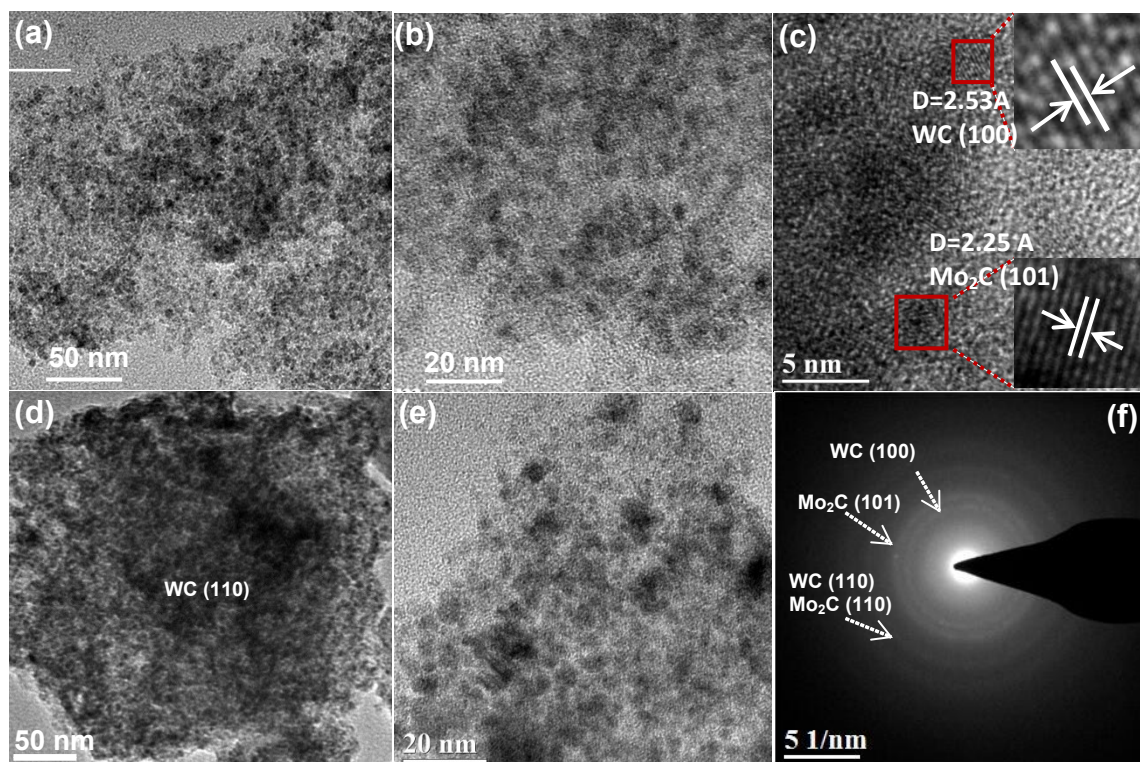


Figure S3. (a, b, d, e) TEM images, (c) HRTEM image and (f) SAED pattern of $(\text{Mo}_2\text{C})_{0.24}$ - $(\text{WC})_{0.52}\text{Cx-QDs/NG}$ electrocatalyst.

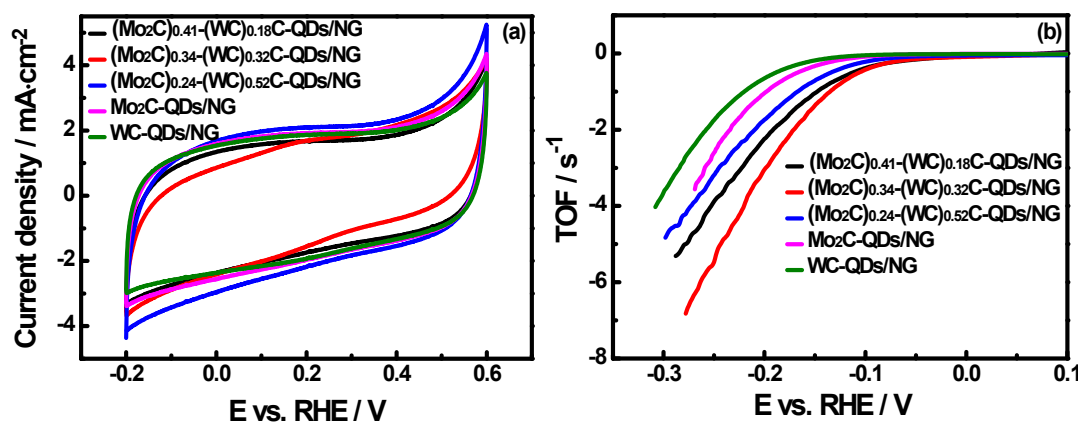


Figure S4. (a) CVs of $\text{Mo}_2\text{C-QDs/NG}$, $(\text{Mo}_2\text{C})_{0.41}-(\text{WC})_{0.18}\text{-QDs/NG}$, $(\text{Mo}_2\text{C})_{0.34}-(\text{WC})_{0.32}\text{-QDs/NG}$, $(\text{Mo}_2\text{C})_{0.24}-(\text{WC})_{0.52}\text{-QDs/NG}$, and WC-QDs/G electrocatalysts in 1.0 M PBS (pH=7) with a scan rate of 50 mV s^{-1} , (b) Calculated TOFs for different catalysts in 0.5 M H_2SO_4 .

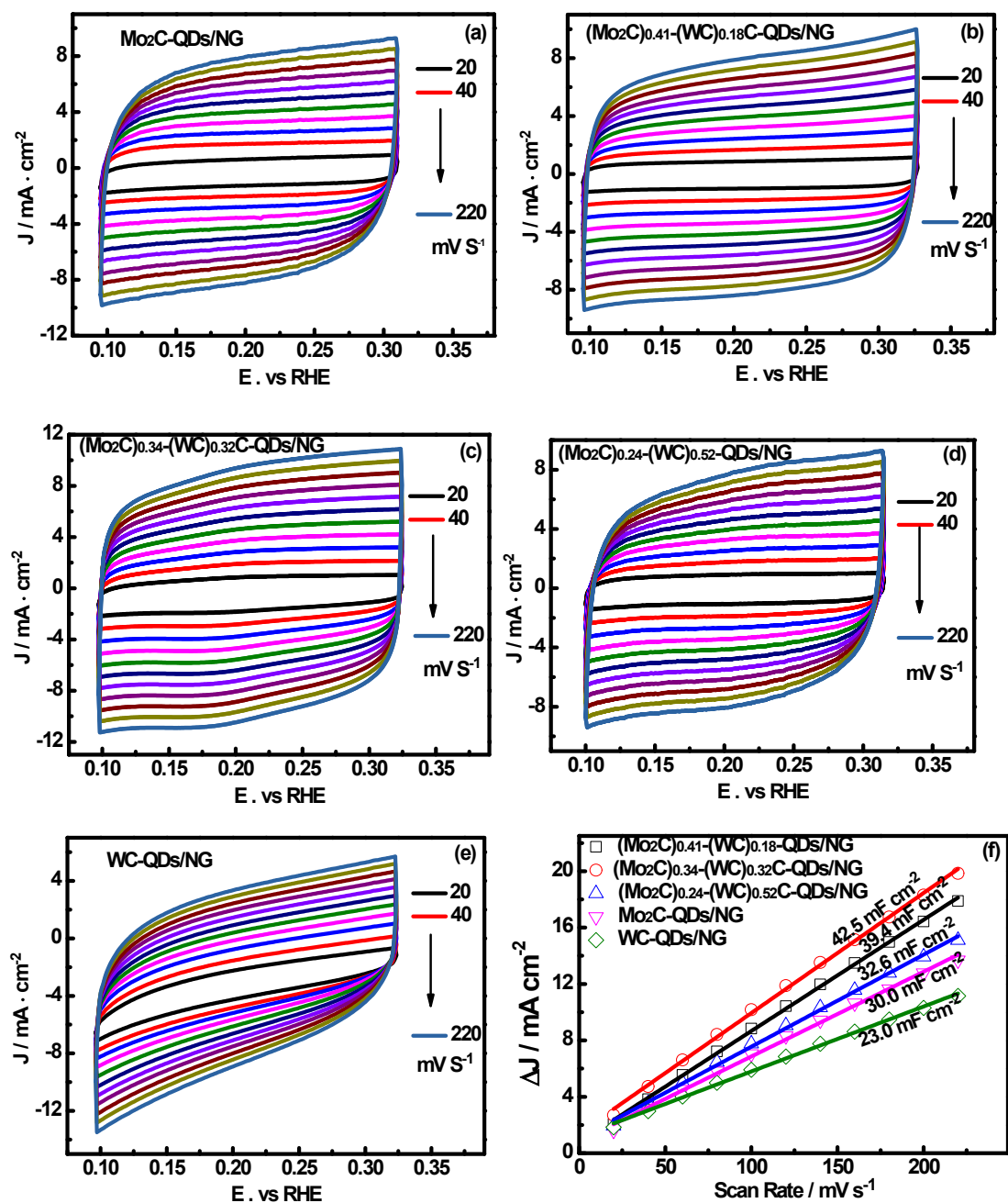


Figure S5. CVs performed at various scan rates in the region of 0.1–0.33 V vs. RHE for (a) Mo $_2$ C-QDs/NG, (b) (Mo $_2$ C) $_{0.41}$ -(WC) $_{0.18}$ -QDs/NG, (c) (Mo $_2$ C) $_{0.34}$ -(WC) $_{0.32}$ -QDs/NG, (d) (Mo $_2$ C) $_{0.24}$ -(WC) $_{0.52}$ -QDs/NG, and (e) WC-QDs/NG electrocatalysts; (f) The differences in current density at 0.20 V vs. RHE plotted against the scan rate and fitted to a linear regression allows for the estimation of C_{dl} .

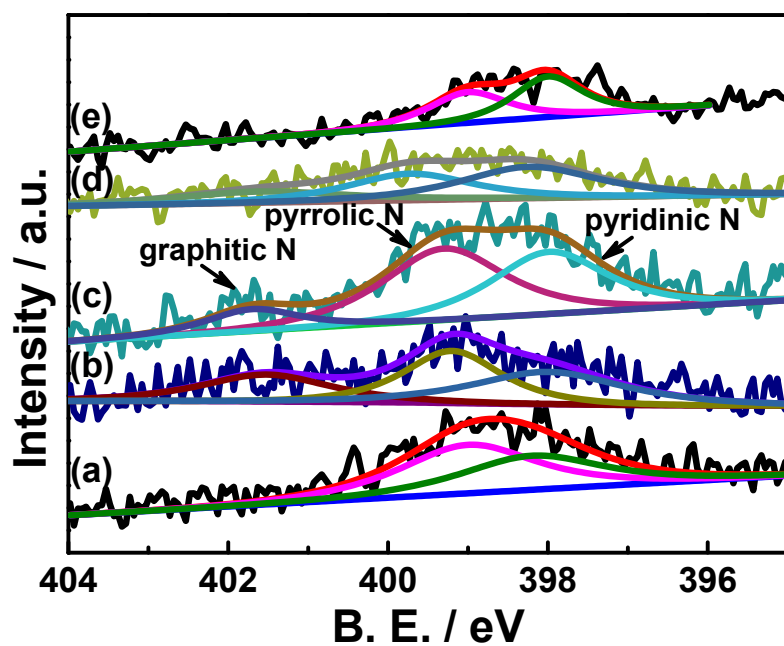


Figure S6. XPS spectra of N1s of (a) Mo₂C-QDs/NG, (b) (Mo₂C)_{0.41}-(WC)_{0.18}-QDs/NG, (c) (Mo₂C)_{0.34}-(WC)_{0.32}-QDs/NG, (d) (Mo₂C)_{0.24}-(WC)_{0.52}-QDs/NG, and (e) WC-QDs/NG.