Supporting Information

In situ fabrication of Nickel/Molybdenum Carbide anchored N-doped graphene/CNT hybrid: An efficient (pre)catalyst for OER and HER

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Content:

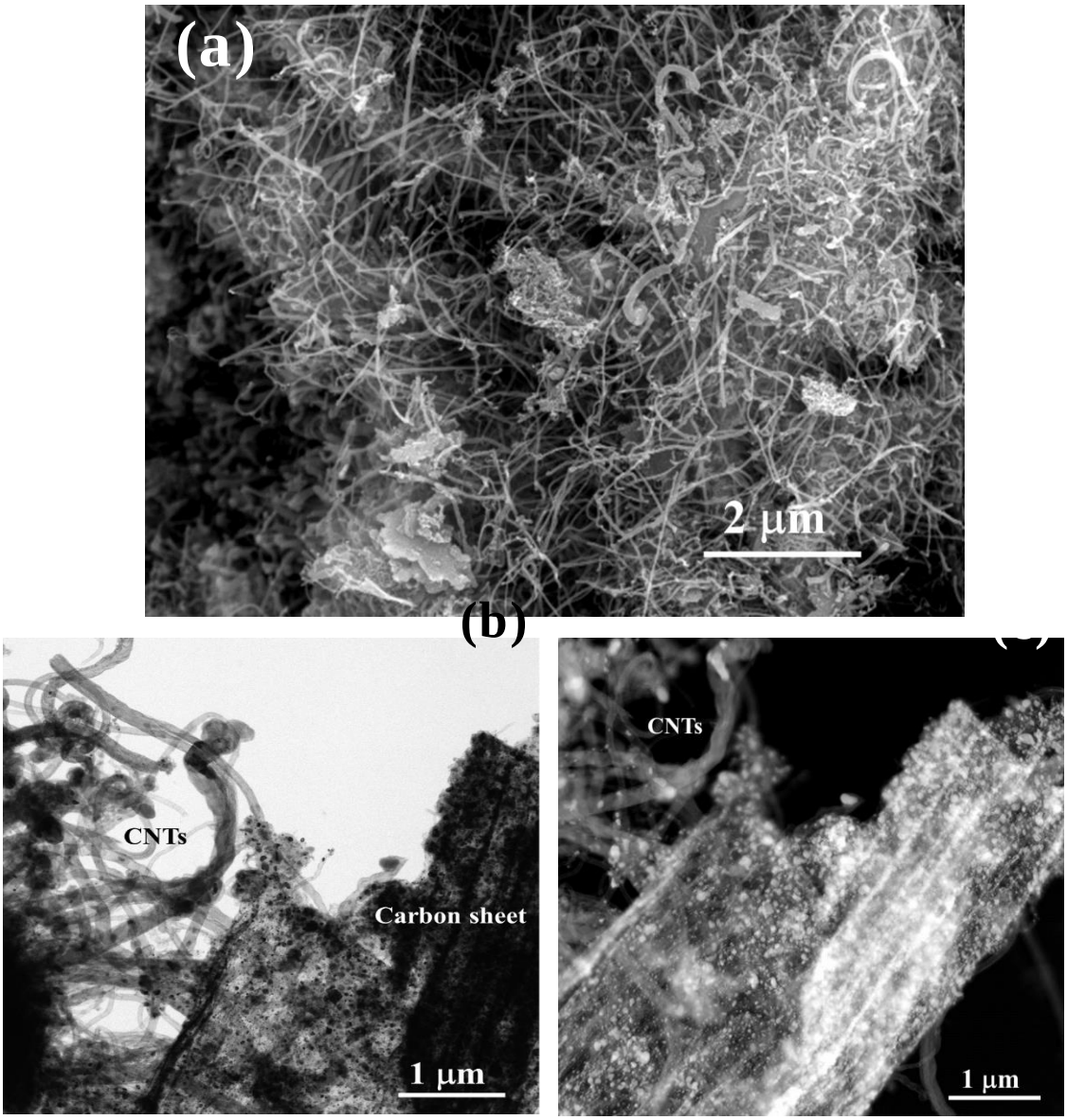

Figure S1. Large areal SEM (a), TEM (b) and HAADF-STEM (c) images of Ni-Mo_xC/NC-100 that show the presence of CNTs along with graphitic carbon sheets.

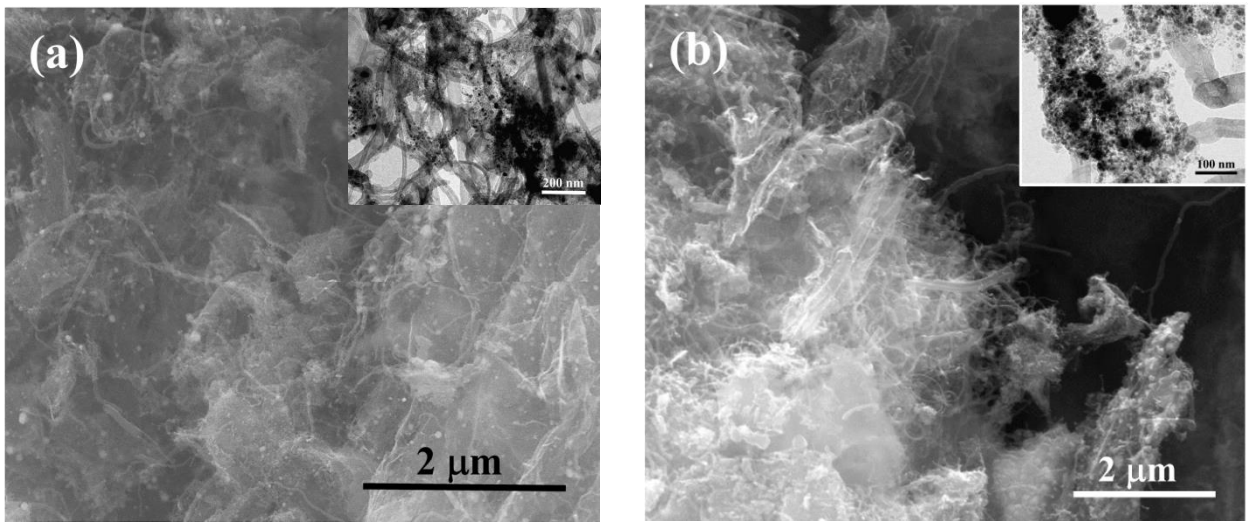

Figure S2. SEM images (insets: TEM images) of (a) Ni-Mo_xC/NC-50 and (b) Ni-Mo_xC/NC-200.

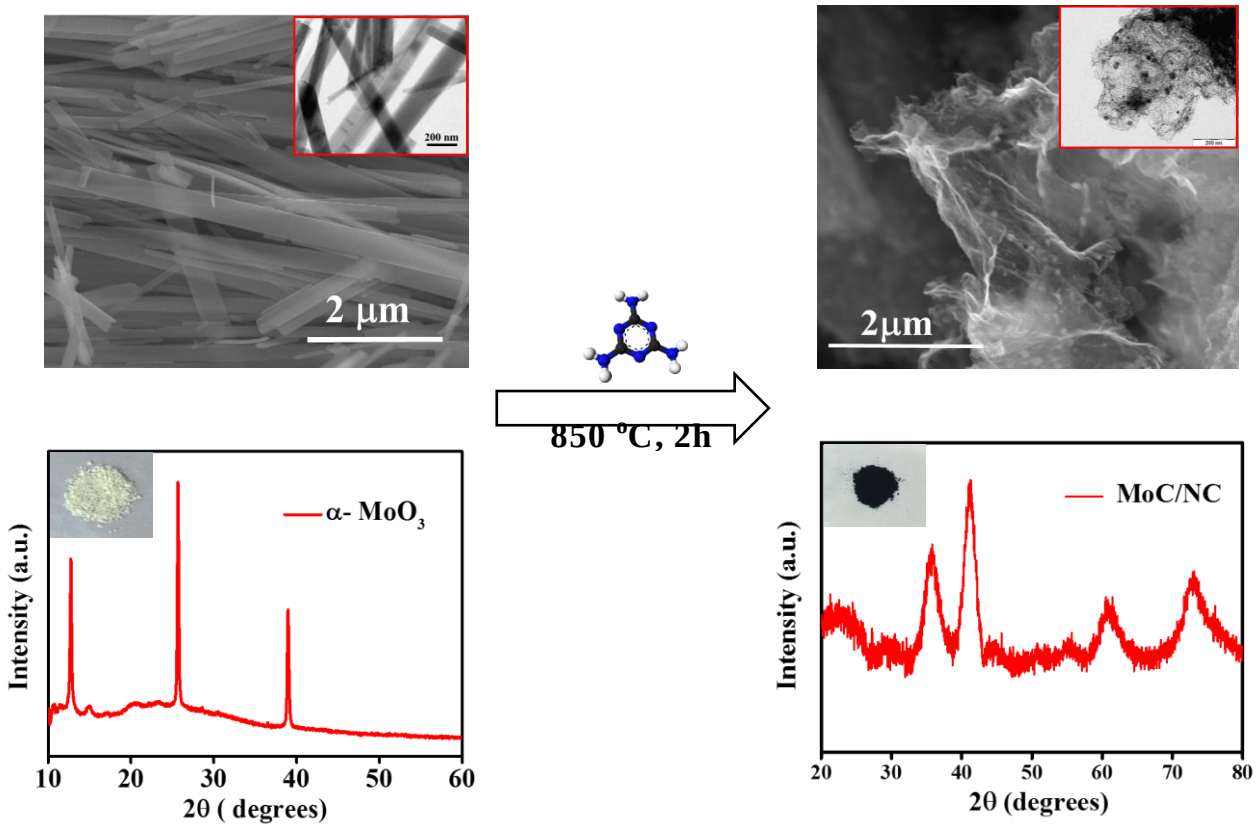

Figure S3. Morphological and structural transformation of MoO_3 nanobelts upon thermal annealing with melamine under identical conditions applied to $NiMoO_4.xH_2O$ nanobelts.

Note the absence of CNTs in the case of MoC/NC hybrid which further validates the notion that Ni nanoparticles are solely responsible for the growth of CNTs in Ni-Mo_xC/NC hybrids (*see main text*). Also, note the visibly broadened XRD peaks of MoC/NC as compared to MoO_3 nanobelts signifying considerable miniaturization during the transformation process.

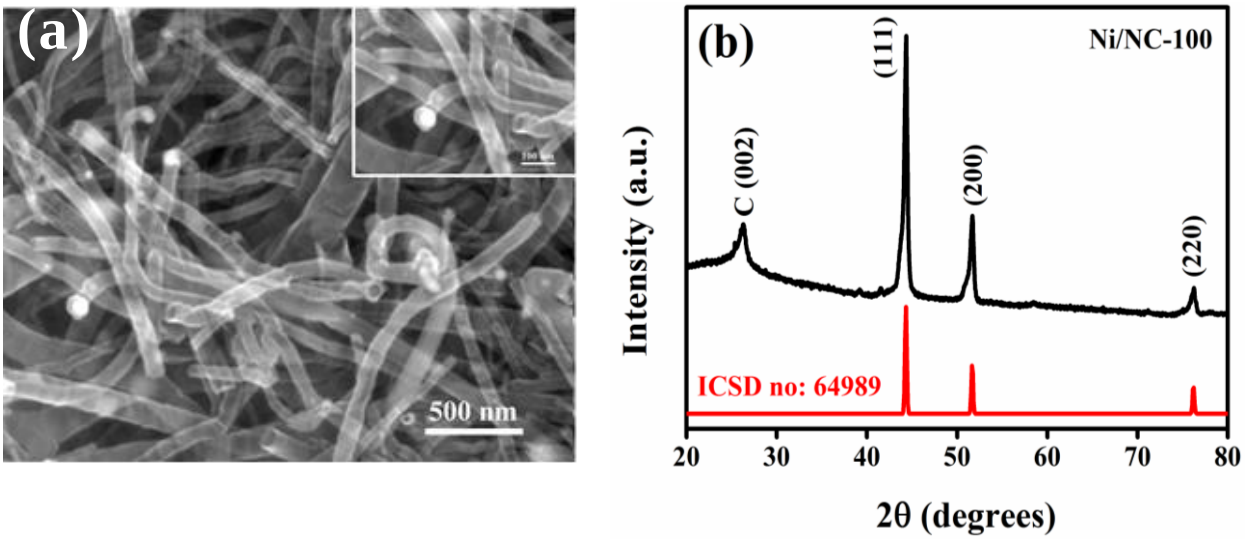

Figure S4. (a) SEM image and (b) XRD pattern of Ni/NC-100.

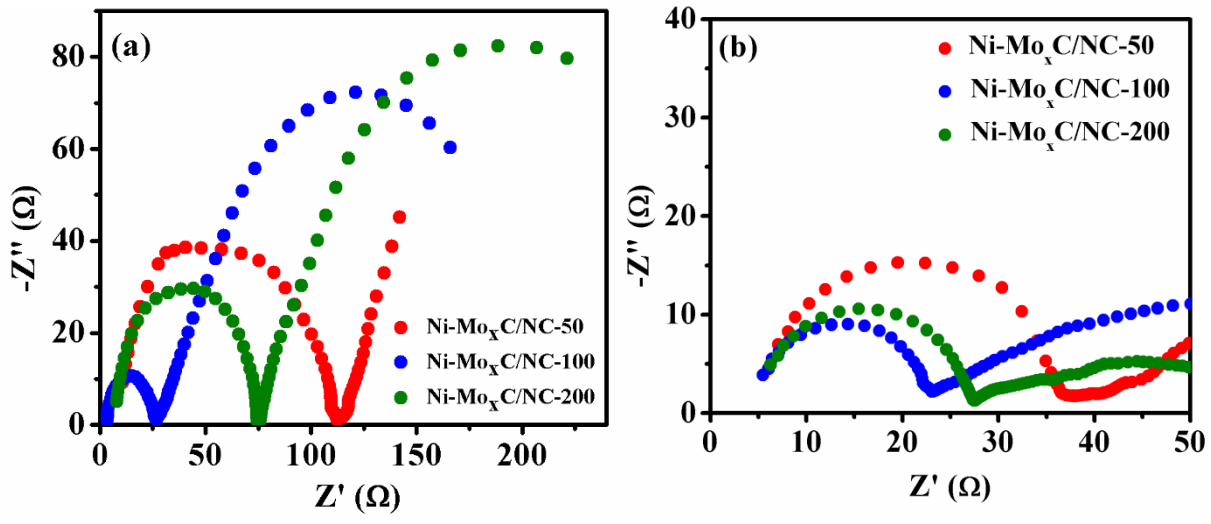

Figure S5. Nyquist plots at (a) HER at an overpotential of 170 mV and (b) OER at an overpotential of 370 mV in 1M KOH.

Table S1. HER activity of some of the recently reported molybdenum carbide-based electrocatalysts in alkaline medium

Catalyst	**Electrolyte**	$\eta_{@J=10mA/cm^2}$	**Tafel slope** (mV/dec)	**Reference**
MoC_x octahedra	1M KOH	151	59	*Nat. Comm.*, **2015**, 6, 6512
Mo_2C NPs	1M KOH	176	58	*J. Mater. Chem. A*, **2015**, 3, 8361
MoCN-3D	1M KOH	122	32.6	*NPG Asia Mater.*,**2016**, 8, e293
Mo_2C-GNR	1M NaOH	217	64	*ACS Sustainable Chem.Eng.*,**2016**, *4*, 6313–6321
Mo_2C NS	1M KOH	205	_	*Nanoscale* **2016**, **8**, 16251–16258
Mo_2C nanocrystals@ N-doped CNTs	1M KOH	257	_	*J. Mater. Chem. A*, **2015**, 3, 5783
Mo_2C@NPC	1M NaOH	144	47.5	*J. Mater. Chem. A*, **2017**, 5, 5178
m-Mo_2C/G	1M KOH	128	56	*ACS Appl. Mater. Interfaces*, **2016**, 8, 18107−18118
Mo_2C-C	1M KOH	169	66	*Nano Energy*, **2017** 32, 511–519
1D-Ni/Mo_2C@C	1M KOH	179	101	*Chem. Sci.*, **2017**, 8, 968
Ni-Mo_xC/NC-100	1M KOH	162	104.8	***This work***

Table S2. OER activity of some of the recently reported transition-metal carbide electrocatalysts in alkaline medium

Catalyst	**Electrolyte**	**η @J=10 mA/cm^2**	**Tafel slope** (mV/dec)	**Reference**
Fe_3C@NCNT/NPC	1M KOH	339	62	*Catal. Sci. Technol.*, **2016**, 6, 6365-6371
Fe_3C@NG-800	0.1M KOH	361	62	*ACS Appl. Mater. Interfaces*, **2015**, 7, 21511−21520
Mo_2C-C	0.1 M KOH	~550	-	*J. Mater. Chem. A*, **2016**, 4, 12583–12590
WC	1M NaOH	413	-	*Meeting Abstracts* **2016**, *MA2016-01*, 1449
Co/WC	1M KOH	417	-	*Meeting Abstracts* **2016**, *MA2016-01*, 1449
Mo_2C-MWCNT	0.1M KOH	~410	-	*ChemCatChem*, **2015**, 7, 3911 – 3915
γ-MoC/Ni@NC	1M KOH	310	62.7	*Nanoscale*, **2017**,9, 5583-5588
1D Ni/Mo_2C@C	1M KOH	368	_	*Chem. Sci.*, **2017**, 8, 968-973
Ni-Mo_xC/NC-100	1M KOH	328	74	***This work***