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Synergism of 1D/2D boride/MXene nanosheets heterojunctions for boosted overall water splitting

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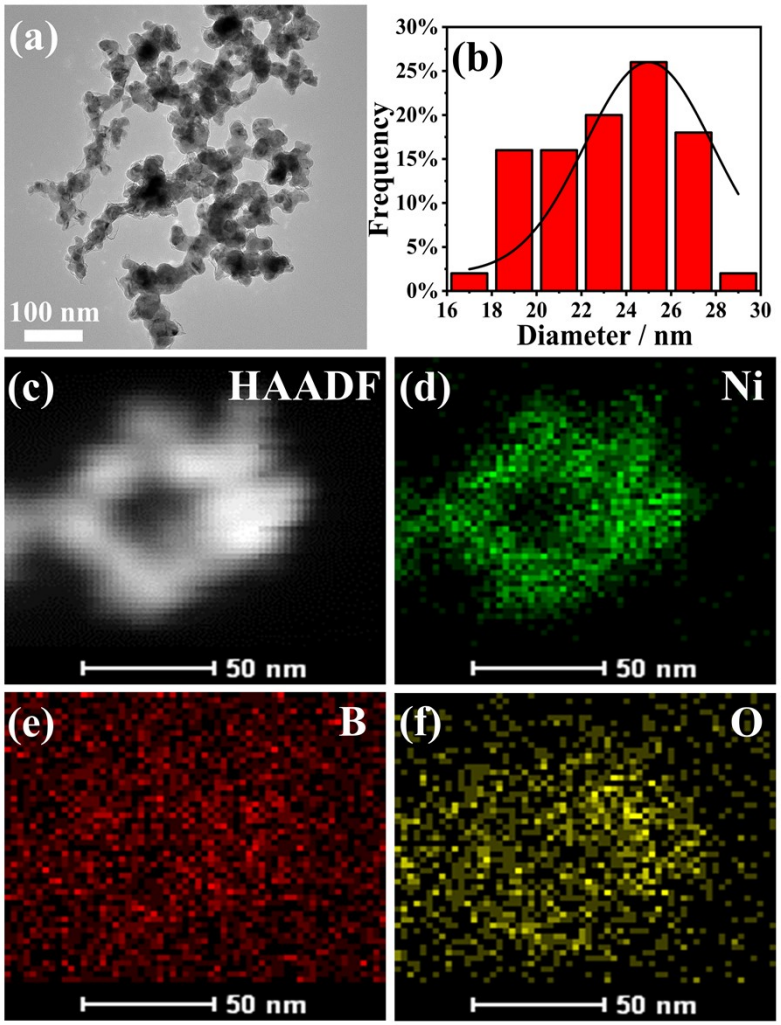

Figure S1. (a) TEM images of Ni_xB. (b) Ni_xB nanoparticles size distribution. (c) HAADF image, and (d-f) its corresponding elemental mapping images of Ni_xB.

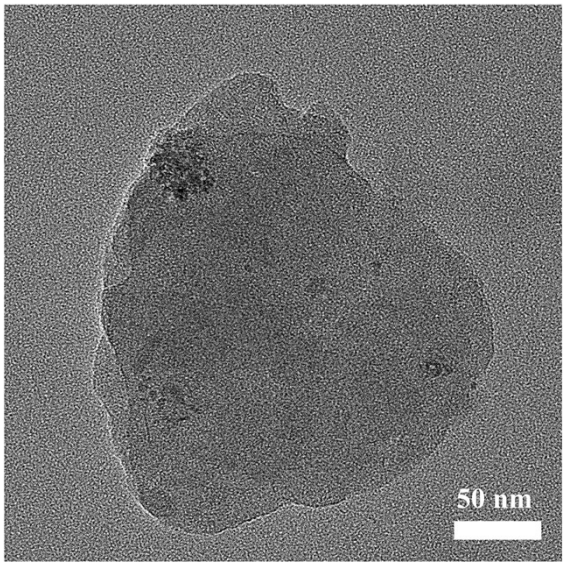

Figure S2. TEM image of $N_{10}TC$ nanosheets.

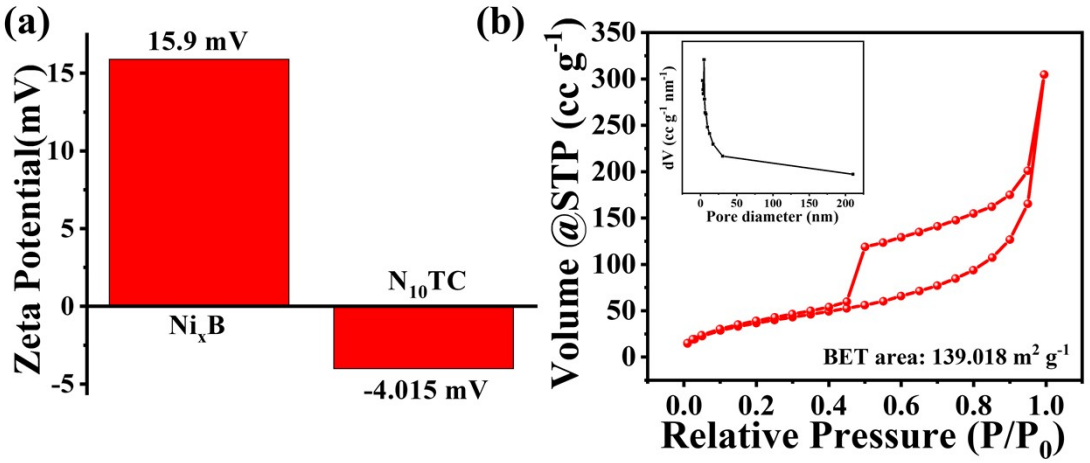

Figure S3. (a) Zeta potentials of Ni_xB and $N_{10}TC$ dispersed in water. (b) N_2-sorption isotherm of $Ni_xB/N_{10}TC$, the inset shows the pore size distribution.

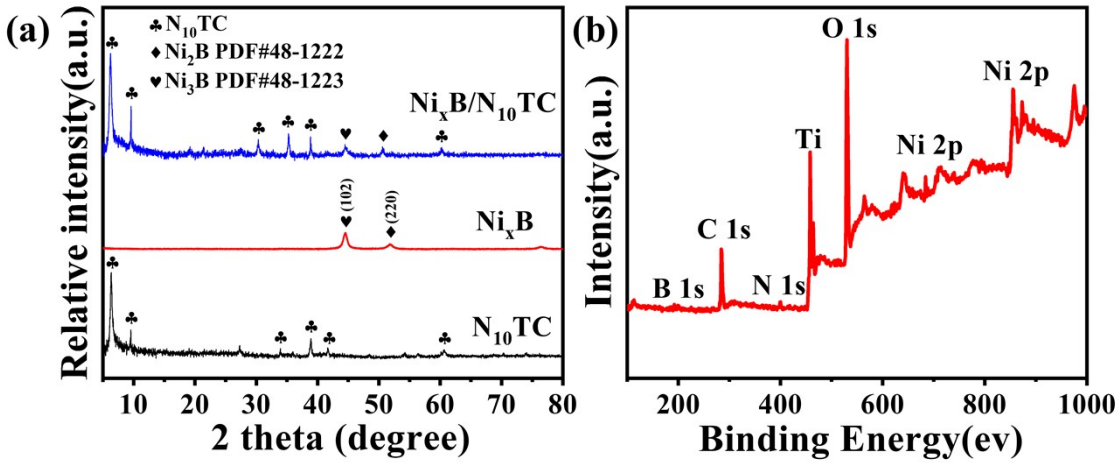

Figure S4. (a) PXRD patterns of $Ni_xB/N_{10}TC$, Ni_xB, and $N_{10}TC$. (b) XPS survey spectra of $Ni_xB/N_{10}TC$.

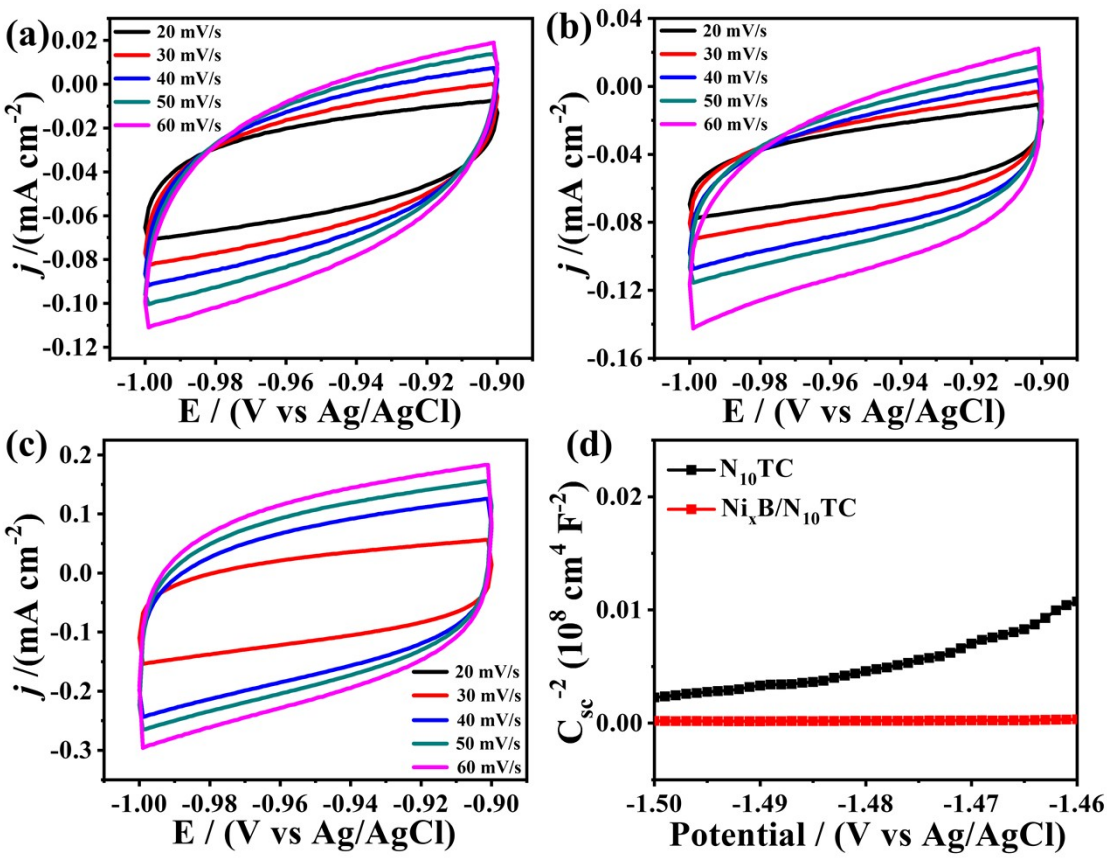

Figure S5. Cyclic voltammograms at different scan rate in the region of -0.9 ~ -1 V vs. Ag/AgCl for (a) $N_{10}TC$, (b) Ni_xB and (c) $Ni_xB/N_{10}TC$. (d) Mott-Schottky plots for $N_{10}TC$ and $Ni_xB/N_{10}TC$ at 1 kHz frequency in 1 M KOH (pH = 14) at room temperature.

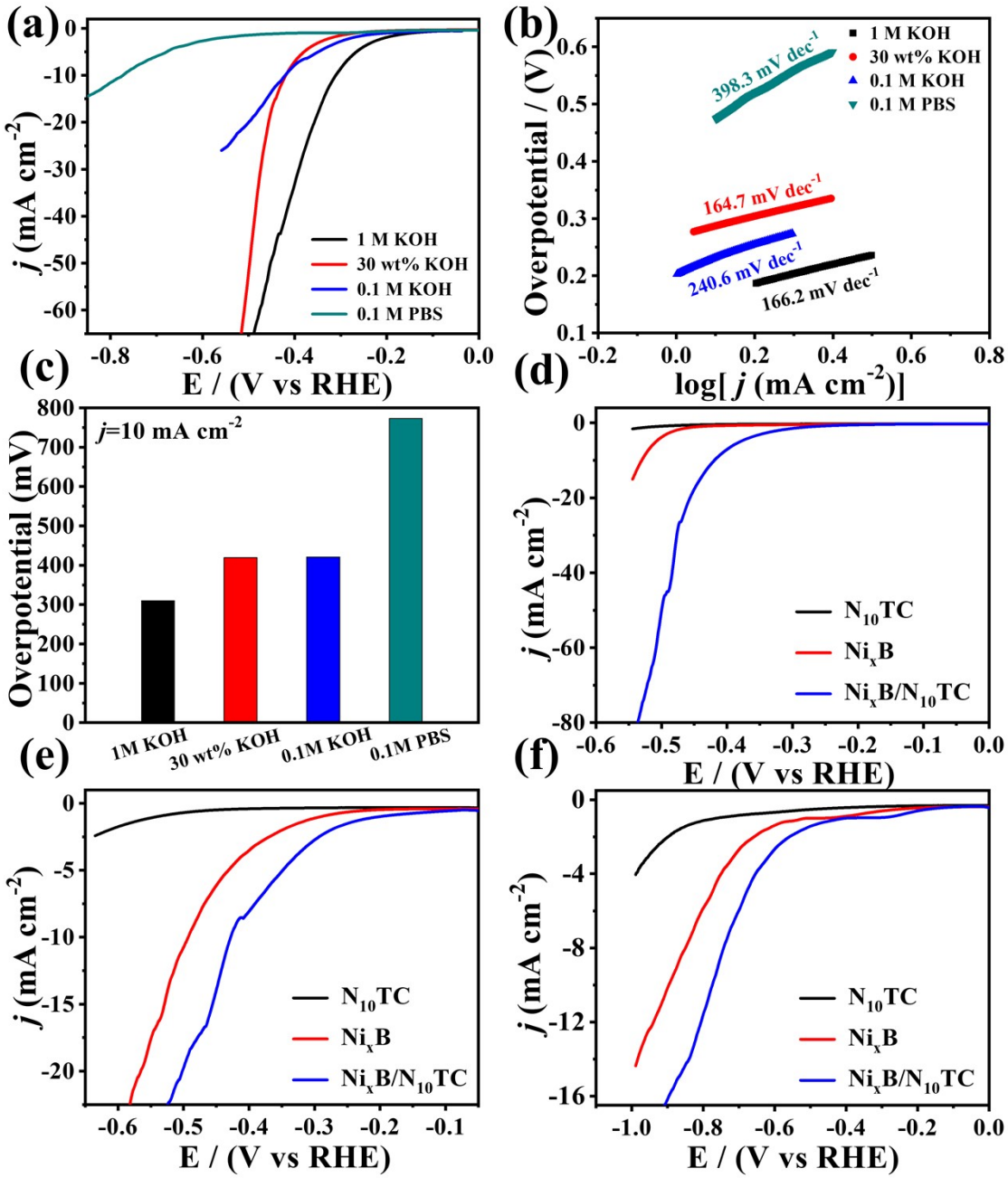

Figure S6. (a) HER polarization curves of $Ni_xB/N_{10}TC$ in different electrolytes; (b) Tafel slopes and corresponding exchange current density (j_0); (c) Overpotentials at 10 mA cm^{-2} for $Ni_xB/N_{10}TC$ electrode in different electrolytes. (d-f) HER polarization curves (1 mV s^{-1}) of different electrodes in different electrolytes, (d) 30 wt% KOH; (e) 0.1 M KOH; (f) 0.1 M PBS(pH=7) solution.

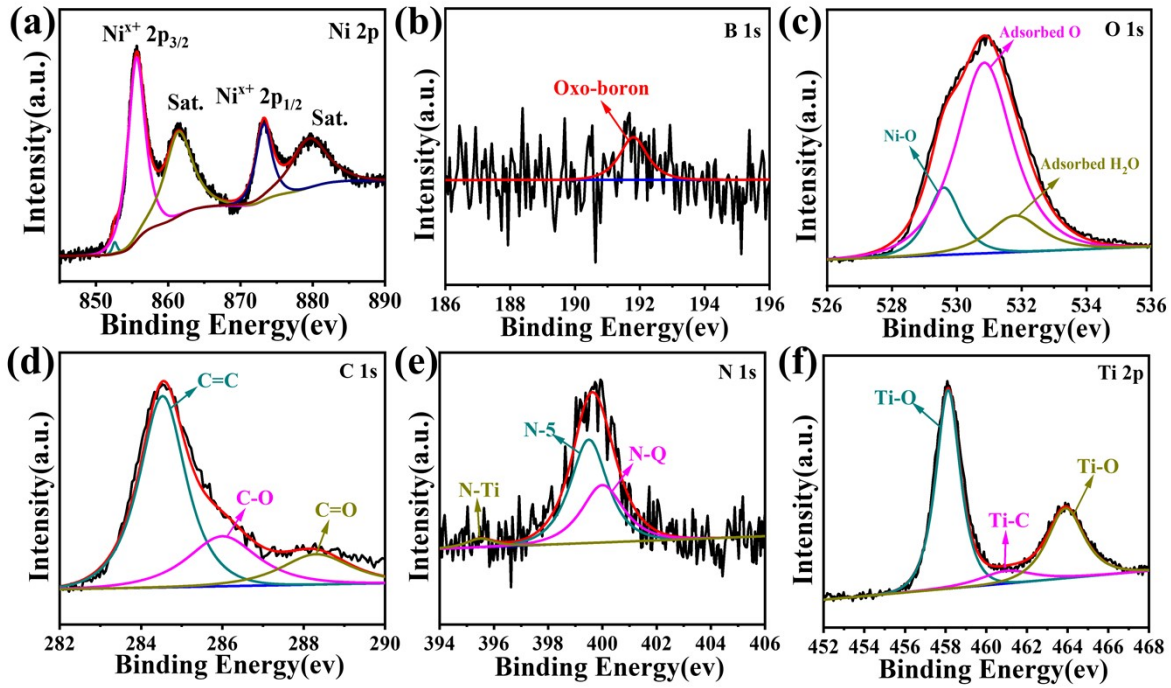

Figure S7. XPS spectra of $Ni_xB/N_{10}TC$ heterojunction after 1000 cycles test.

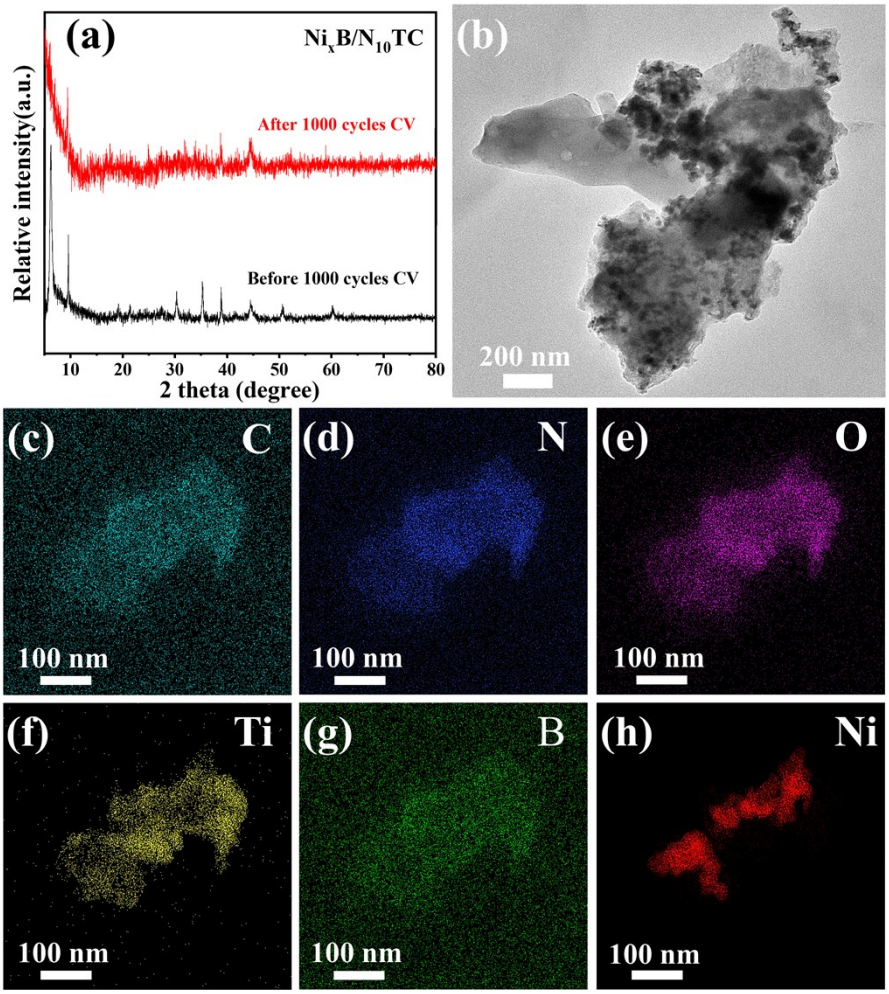

Figure S8. (a) XRD, (b)TEM and (c-h) its corresponding elemental mapping for the sample of $Ni_xB/N_{10}TC$ heterojunction after HER stability test.

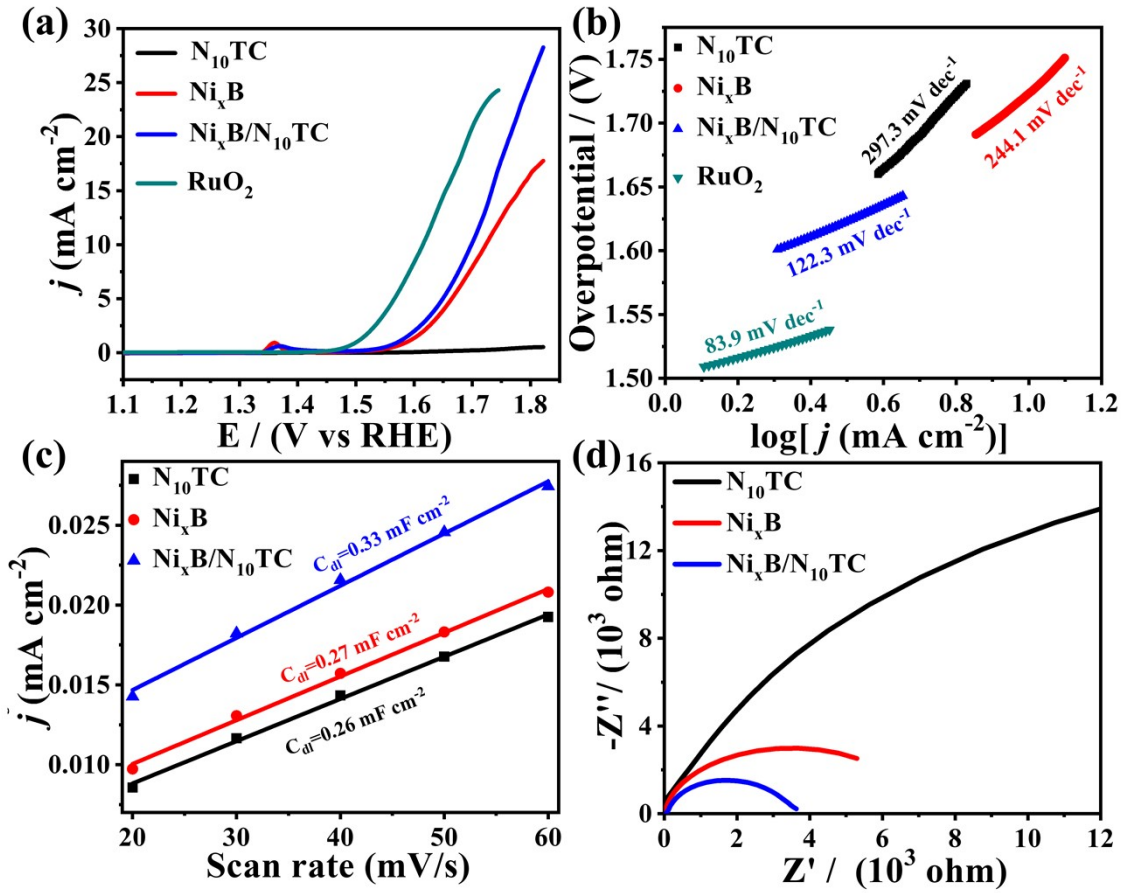

Figure S9. (a) Polarization curves with 80% iR-compensation and (b) Tafel plots of $N_{10}TC$, Ni_xB, $Ni_xB/N_{10}TC$, and commercial RuO_2 for OER in 1.0 M KOH electrolyte. (c) C_{dl} values estimated in 1.0 M KOH electrolyte. (d) Electrochemical impedance spectroscopy of $N_{10}TC$, Ni_xB, $Ni_xB/N_{10}TC$.

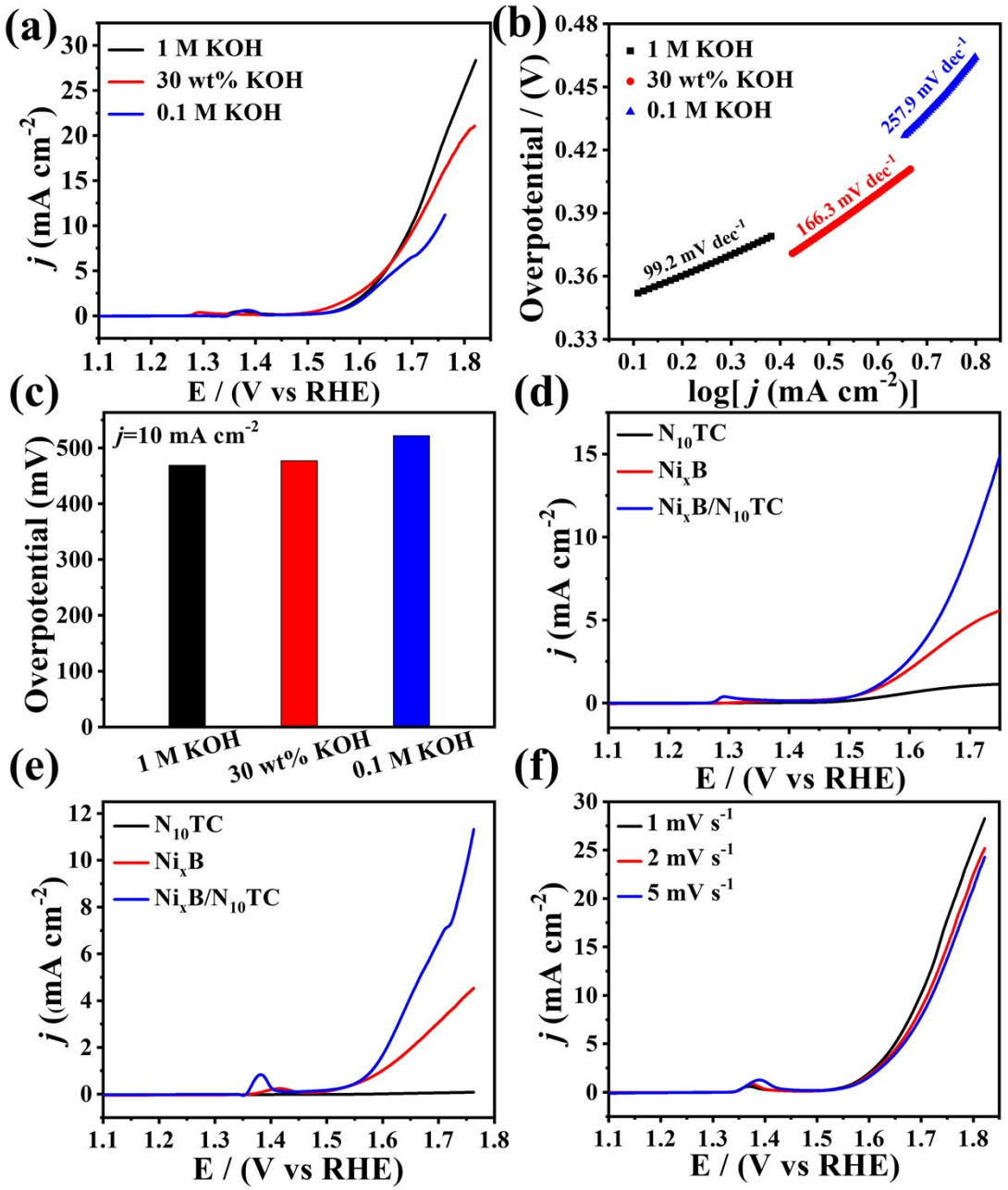

Figure S10. (a) OER polarization curves of $Ni_xB/N_{10}TC$ in different electrolytes; (b) Tafel slopes and corresponding exchange current density (j_0); (c) Overpotentials at 10 mA cm^{-2} for $Ni_xB/N_{10}TC$ electrode in different electrolytes. (d-e) OER polarization curves (1 mV s^{-1}) of different electrodes in different electrolytes, (d) 30 wt% KOH; (e) 0.1 M KOH. (f) OER polarization curves of $Ni_xB/N_{10}TC$ heterojunction under various sweep speeds.

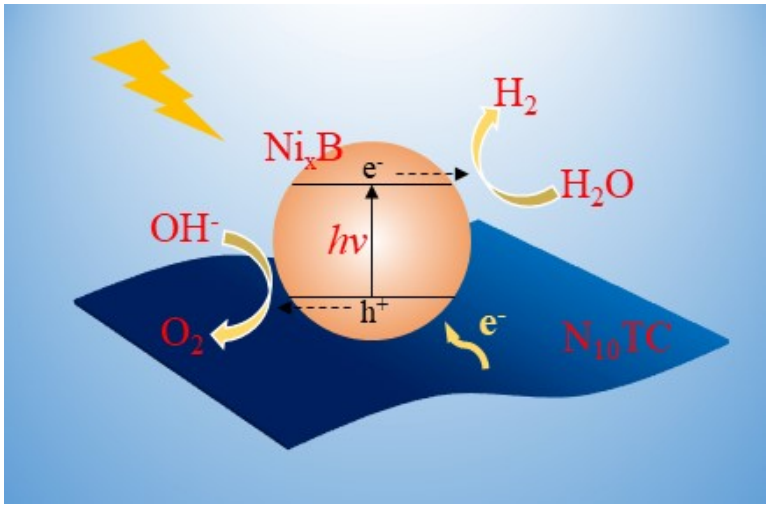

Figure S11 The potential mechanism of the catalysis process.

Table S1 Comparison of catalytic performance with the most recently reported water-splitting catalysts.

Catalyst	Substrate used	Electrolyte	Loading amount (mg cm^{-2})	η_{10} (mV)		A/g	Ref.
				HER	OER		
$Ni_xB/N_{10}TC$	**GC**	**1 M KOH**	**0.11**	**310**	**468**	**90.91**	***This work***
Ni_2B-gC_3N_4	GC	1 M KOH	–	707	–	–	*ACS Sustainable Chem. Eng.* ***2018**, 6, 16198*
Ni_xB-300	GC	1 M KOH	0.21	–	380	47.62	*Adv. Energy Mater.* ***2017**, 7, 1700381*
Co_2B-$CoSe_2$	GC	1 M KOH	0.40	300	320	25	*ACS Appl. Mater. Interfaces* ***2017**, 9, 39312*
Etched Mo-Al-B	Unsupported	0.5 M H_2SO_4	–	361	–	–	*Chem. Mater.* ***2017**, 29, 8953*
MoS_2/Ti_3C_2	GC	0.5 M H_2SO_4	0.35	280	–	28.57	*Int. J. Hydrogen Energy* ***2019**, 44, 965-976*
$NiCoS/Ti_3C_2T_x$	GC	1 M KOH	0.21	–	365	47.62	*ACS Appl Mater Interfaces* ***2018**, 10, 22311-22319*