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Sustainable Energy Fuels, 2018, , 229

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Herein, a hybrid catalyst of Pt/$CoNiO_2$ on carbon nanotubes (Pt/$CoNiO_2$–CNTs) has been successfully synthesized by a facile and cost-effective method, and its crystal structures, chemical valence states, and morphologies have been characterized in detail. CO stripping voltammograms reveal that the adsorbed CO_{ads} on the active sites of the Pt/$CoNiO_2$–CNT catalyst is easily oxidized at a lower potential (−0.60 V) as compared to the Pt particles on rGO (−0.35 V) and acid-treated CNTs (−0.36 V). Cyclic voltammograms demonstrate that the designed Pt/$CoNiO_2$–CNT catalyst possesses an ultrahigh electrocatalytic activity (1136.2 mA mg_{Pt}^{-1}) for ethanol oxidation, which is 5.1 and 3.0 times higher than that of Pt/rGO (221.6 mA mg_{Pt}^{-1}) and Pt/CNTs (375.4 mA mg_{Pt}^{-1}), respectively. The Tafel plot of Pt/$CoNiO_2$–CNTs is 205 mV dec^{-1}, indicating much faster reaction kinetics than that of the compared catalysts. In addition, the outstanding long-term stability indicates that the designed Pt/$CoNiO_2$–CNT catalyst exhibits expected application prospects in direct alkaline ethanol fuel cells. Moreover, the catalytic mechanism of the hybrid Pt/$CoNiO_2$–CNTs has been proposed and discussed *via* C2 and C1 pathways with respect to the final products for CH_3COO^- and CO_3^{2-}, respectively.

Received 10th August 2017
Accepted 24th October 2017

DOI: 10.1039/c7se00392g

Wi h he increasing global arming and poll ion, more co n ries and organi a ions are pa ing more e plici a en ion o s s ainable energ de elopmen .[1,2] Lo -carbon inno a ion and rene able energ echnologies, s ch as f el cells, solar cells *etc.*,[3] ha e aro sed idespread in eres in he pas fe decades; among hese, efficien f el cell de ices can direc l con er chemical energ in o elec rici i h almos no poll ion e cep for some CO_2 gas.[4,5] Especiall , direc alcohol f el cells ha e a rac ed significan a en ion d e o heir niq e ad an ages s ch as fer ile so rce ma erials, being ligh eigh , and eas opera ions.[6,7] Beca se of heir m ch q icker f el o ida ion and o gen red c ion kine ics, direc alkaline f el cells (DAFC) ha e been de eloped as one of he mos sophis ica ed f el cells as compared o he acid f el cells a lo empera res.[8–12] Moreo er, he eas -poisoning na re of P -based ca al s s in an acidic sol ion is ano her dri ing force ha promo es he de elopmen of alkaline f el cells.[13–16]

Recen l , o gen red c ion reac ions in an alkaline sol ion ha e been rapidl de eloped, and o s anding progress has been made in he aspec s of mechanis ic s d and ca al ic performance.[17–19] Ho e er, mos of he designed alkaline anode ca al s s, incl ding P -based anode ca al s s, are kine icall sl ggish and do no sa isf he req iremen s for prac ical applica ions.[20–23] Spendelo and Wiecko ski ha e re ie ed ario s P -based ca al s s in alkaline media o er he pas fe decades and nco ered ha noble me al loading, par icle si e dis rib ion, and CO poisoning of P are he mos impor an barriers inhibi ing he de elopmen of hese ca al s s.[24] Therefore, i is rgen o de elop effec i e s ra egies o impro e he ac i i and d rabili of P -based ca al s s in alkaline alcohol f el cells.

Pre io s s dies ha e re ealed ha ransi ion me al o ides can resis alkaline corrosion and help o impro e heir abili of an i-CO poisoning in f el cells.[25–27] Among hem, spinel nickel cobal i e ($CoNiO_2$), hich has a rela i el lo price and e hibi s en ironmen all friendl fea res, has a rac ed significan a en ion.[28,29] Some s dies ha e sho n ha he ear h-ab ndan $CoNiO_2$ possesses e cellen elec rochemical proper ies and e hibi s a m ch higher elec rical cond c i i han cobal

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† Elec ronic s pplemen ar informa ion (ESI) a ailable. See DOI: 10.1039/c7se00392g

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o ides or nickel o ides alone.[30] In addi ion, $CoNiO_2$, as a highl ac i e ca al s , has been e ensi el e plored in he a er spli ing reac ion in alkaline media o er he pas fe ears.[31–33] Ho e er, applica ions of $CoNiO_2$ in direc alkaline e hanol f el cells are q i e rare; h s, he s d of $CoNiO_2$-based h brid ma erials as an efficien anode ca al s is s ill highl significan .

In his s d , e ha e s ccessf ll s n hesi ed he P /$CoNiO_2$–CNT h brid ma erial, in hich he P par icles are niforml dispersed on he s rface of a $CoNiO_2$–CNT s ppor b a facile red c ion me hod. The as-s n hesi ed P /$CoNiO_2$–CNT h brid ca al s e hibi s m ch higher ca al ic ac i i and long- erm s abili han P /rGO and P /CNT ca al s s for e hanol elec ro-o ida ion in alkaline media. Moreo er, he ob ained P -based h brid ca al s e hibi s s perior an i-CO poisoning abili .

Materials

All chemical reagen s sed in his e perimen ere of anal ical grade. $Ni(NO_3)_2 \cdot 6H_2O$, $Co(NO_3)_2 \cdot 6H_2O$, $H_2P Cl_6$, NH_4F, $NaBH_4$, H_2SO_4, HNO_3, e hanol, Nafion, and ce l rime h lammoni m bromide (CTAB, Alfa Aesar) ere proc red commerciall and sed as recei ed i ho f r her p rifica ion. The CNTs i h a diame er of 40–60 nm, leng hs of 5–15 mm, and a p ri of 98% sed in his s d ere p rchased from Shen hen Nano- echnologies Por Co. L d. (Shen hen, China).

Preparation of CNTs and $CoNiO_2$–CNTs

The commercial CNTs ere ini iall rea ed b a pical h dro- hermal me hod.[34] Ra -CNT po ders ere dispersed in a H_2SO_4–HNO_3 sol ion (8.0 M for each acid) a a ba h empera re of 80 C and hen rea ed for 2 h nder h dro- hermal condi ion. The prod c as ashed i h deioni ed a er and dried in a ac m o en a 70 C for 12 h for f r her se.

The $CoNiO_2$–CNT h brid composi es ere ob ained hro gh a h dro hermal process and a s bseq en high- empera re calcina ion, in hich 50 mg acid- rea ed CNTs, 0.29 g $Ni(NO_3)_2 \cdot 6H_2O$, 0.58 g $Co(NO_3)_2 \cdot 6H_2O$, 0.90 g rea, and 0.22 g NH_4F ere one-s ep dissol ed in 90 mL deioni ed a er and hen l rasonica ed for 60 min. The as-ob ained s spension as hen ransferred in o a Teflon-lined s ainless-s eel a ocla e (lo er han he o al ol me of 2/3) and h dro hermall rea ed a 140 C for 7 h. After being cooled do n o room empera re, he res l ing prod c s ere fil ered and ashed i h ab ndan deioni ed a er and e hanol o remo e he resid es. The cleaned prod c s ere p in a ac m o en for 12 h a 70 C. After his, he dried samples ere placed in a N_2-pro ec ed f rnace, and he empera re as slo l increased o 400 C and main ained for ano her 2 h. The ielded prod c s ere deno ed as $CoNiO_2$/CNT h brid composi es.

Preparation of the Pt/$CoNiO_2$–CNT catalysts

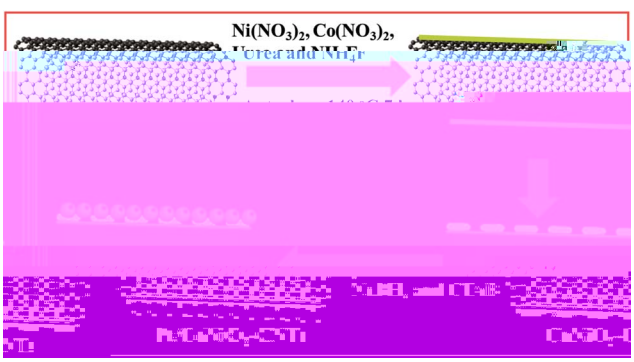
The P /$CoNiO_2$–CNT h brid ca al s as ob ained hro gh an impregna ion me hod sing $NaBH_4$ and CTAB as red cing and pro ec an agen s, respec i el ; herein, he heore ical loading of P on he $CoNiO_2$–CNT s rface as fi ed a 20 %. T picall , 50 mg of $CoNiO_2$/CNTs and 3.3 mL of 18.96 mM $H_2P Cl_6$ ere ini iall added o a 60 mL mi re sol ion of e hanol/ a er (1 : 1, / ra io). After igoro s s irring for 0.5 h, 20 mL freshl prepared red cing sol ion (40 mg $NaBH_4$ and 15 mg CTAB) as slo l added drop ise o he abo emen ioned mi re sol ion nder igoro s s irring condi ion. The res l ed sol ion as con in o sl s irred for ano her 24 h and hen ashed i h e cess deioni ed a er. The recei ed solid composi es ere dried in a ac m o en a 80 C for 5 h and deno ed as P /$CoNiO_2$–CNTs (Scheme 1). For be er comparison, he P par i- cles on acid- rea ed CNTs and rGO (20 % P) ere also prepared sing a similar e perimen al me hod, in hich rGO as s n hesi ed *via* a modified H mmers me hod.[35]

Spectroscopic characterizations

The s r c res, componen s, and morphologies of he samples ere charac eri ed b scanning elec ron microscop (SEM, FEI Q an a 200 FEG, Holland), ransmission elec ron microscop (TEM, JEM-2100F, Japan), high-resol ion ransmission elec- ron microscop (HRTEM), energ -dispersi e X-ra spec roscop (EDS, FEI Q an a 200 FEG, Holland), X-ra diffrac ion (XRD, Rigak D/MAX 2500 /pc (Japan) diffrac ome er i h C Kα radia ion), energ -dispersi e spec roscop (EDX, FEI Q an a 200 FEG, Holland), Raman spec roscop , and X-ra pho oelec- ron spec roscop (XPS, JPS-9010TR (Japan) i h Mg Kα radia- ion). Ind c i el co pled plasma anal sis (ICP, IRIS In repid II XSP) as sed o de ermine he real me al loading of he as- prepared ca al s .

Electrochemical measurements

A general hree-elec rode s s em as sed o e amine all he elec rochemical da a *via* a CHI 660C elec rochemical orking s a ion a room empera re. A glass carbon elec rode, P foil, and sa ra ed calomel elec rode (SCE) ere sed as he orking, co n er, and reference elec rodes, respec i el . The glass carbon elec rode as firs polished b Al_2O_3 po der and hen s bseq en l cleaned in e hanol and a er. The orking elec rodes ere prepared as follo s: 2.0 mg ca al s as



1 Schematic of the preparation process of the Pt/$CoNiO_2$–CNT composite.

dispersed in 400 μL H_2O/C_2H_5OH (/ = 1 : 1) and l ra- sonica ed for 5 min o form a niform ca al s ink. Then, 5 μL of ca al s ink as pipe ed on o he glass carbon elec rode s rface ($\phi = 3$ mm); after dr ing, 5 μL dil ed Nafion (0.5 %) as dropped on o he ca al s o a oid e folia ion. The P loading con en on he orking elec rode is *ca.* 70.8 μg cm^{-2}.

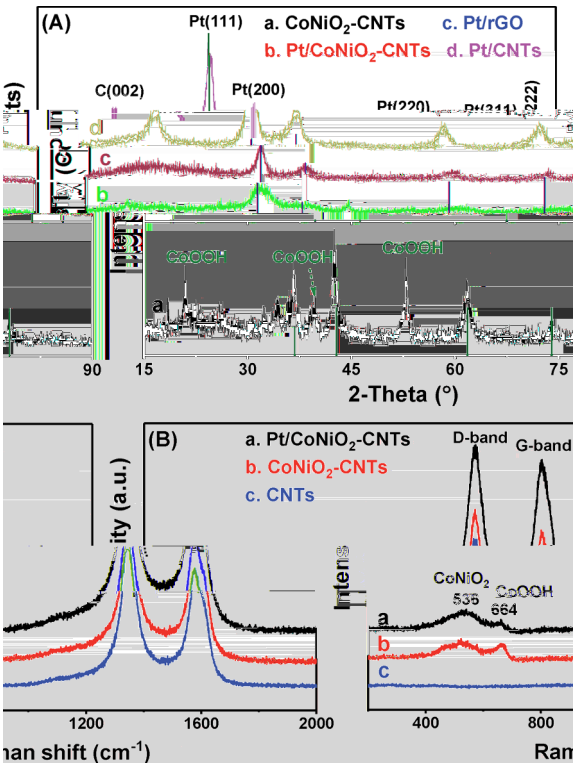
CO-s ripping c clic ol amme r (CV) as sed o e al a e he elec rochemical ac i e s rface area (EAS) of differen ca a- l s s in a 1.0 M KOH sol ion. Firs , CO as p rged in o a 1.0 M KOH sol ion, hen a cons an po en ial of −0.3 V (*vs.* SCE) as se , and he s s em as con in o sl r n for 45 min, d ring hich he CO gas as nin err p edl b bbled in o he sol ion in he ini ial 30 min, and hen, N_2 gas as b bbled in o he sol ion for 15 min o remo e he dissol ed CO gas. After his, pical CV c r es i h con in o s o c cles ere ob ained in he sol ion in he range from −0.8 V o 0.3 V a a scan ra e of 50 mV s^{-1}. The e hanol elec rochemical o ida ion as in es i- ga ed in a N_2-sa ra ed 1.0 M KOH + 0.5 M CH_3CH_2OH sol ion a a scan ra e of 50 mV s^{-1} for all he CV c cles. The long- erm s abili as de ermined a a posi i e po en ial of 0.3 V for 3600 s. All he elec rochemical es s ere carried o a ambien empera re (25 1 C).

Schematic synthesis of Pt/$CoNiO_2$–CNTs

The prepara ion process for he P /$CoNiO_2$–CNT ca al s is sho n in Scheme 1. The acid- rea ed CNTs ere ini iall mi ed i h $Ni(NO_3)_2$, $Co(NO_3)_2$, rea, and NH_4F in deioni ed a er *via* iolen l rasonic rea men for one ho r. The res l ing sol - ion as ransferred in o an a ocla e and hea ed o 140 C for se en ho rs. After rea men , he Co–Ni h dro ide species ere homogeneo sl dis rib ed on he s rface of he acid- rea ed CNTs. After calcina ion a 400 C for o ho rs, he poro s Co–Ni o ide species as formed on he CNT s rface. After his, he added P Cl_6^{2-} ions s rongl adsorbed on o he s rface of Co–Ni o ides/CNTs *via* elec ros a ic in erac ion force. After he mi re sol ion of $NaBH_4$ and CTAB as added, he prec rsor P Cl_6^{2-} ions slo l red ced o P seed cr s als in he ini ial s age. Thro gh in erac ion i h he ind ced CTAB, he P cr s al formed a special s r c re in he s bseq en cr s al gro h process. After en -fo r ho rs, he s rfac an and ario s imp ri ies ere remo ed, and he arge ed ca al s as recei ed. The real P me al loading on he $CoNiO_2$–CNT s ppor as de ec ed b he ind c i el co pled plasma (ICP) me hod. The es ing res l s sho ha he percen age of P is 21.3% on he P /$CoNiO_2$–CNT h brid ca al s , hich is consis en i h he heore ical res l s.

XRD patterns and Raman spectrum analysis

The as-prepared composi es ere ini iall e al a ed b X-ra diffrac ion (XRD). As sho n in Fig. 1A, he XRD pa ern sho s ha he main peaks of he prepared samples are consis en i h he s andard pa erns of $CoNiO_2$ (JCPDS: 10-0188). In addi ion, some small mess peaks are de ec ed, hich can be ascribed o he doped CoOOH species.[36] After ind cing P par icles, he



. .1 (A) XRD patterns of (a) $CoNiO_2$–CNTs, (b) Pt/$CoNiO_2$–CNTs, (c) Pt/rGO and (d) Pt/CNTs. (B) Raman spectrum of (a) Pt/$CoNiO_2$–CNTs, (b) $CoNiO_2$–CNTs, and (c) CNTs.

XRD pa erns (Fig. 1A) sho ha all samples e hibi fi e main peaks loca ed a 39.8, 46.2, 67.5, 81.3, and 85.7 , hich belong o he face cen ered c bic s r c res of me al P (111), (200), (220), (311), and (222), respec i el (JCPDS: 04-0802).[37] I sho ld be no ed ha a pical peak loca ed a 26 is deri ed from he diffrac ion pa ern of he carbon (002) plane.[38] Compared i h ha of P /rGO and P /CNTs, he in ensi of he peak for P / $CoNiO_2$–CNT h brid ma erial is eaker, and he id hs of he peaks are m ch broader; his indica es ha he par icles of P on $CoNiO_2$–CNTs are m ch smaller han o hers. In addi ion, an apparen peak shift co ld be obser ed for P (220) on P / $CoNiO_2$–CNTs in comparison i h he case of o her o ca a- l s s; his indica ed ha some P allo migh coe is in he s n hesi ed composi e. Generall , he Scherrer eq a ion is sed o calc la e he si e of he P par icles. The a erage par icle si e of he P par icles is es ima ed b he follo ing eq a ion:[39]

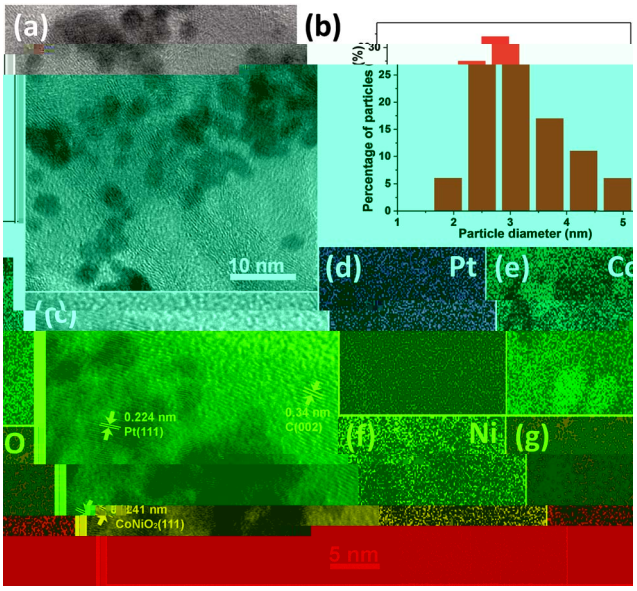
$$D = K\lambda/\beta \cos\theta \quad (1)$$

here D (nm) is he calc la ed a erage diame er of he P par icles, λ is he sed a eleng h of X-ra (0.154056 nm for C Kα), K is he Scherrer cons an (0.89), θ is he Bragg diffrac ion angle, and β is he half heigh id h of he peak in radians. The a erage par icle si e of differen ca al s s as calc la ed o be 3.3, 4.1, and 5.7 nm for he P par icles on $CoNiO_2$–CNT, rGO, and CNT s ppor s, respec i el . The smalles par icle si e indica es ha he $CoNiO_2$–CNT s ppor is beneficial o mini- mi e he par icle dis rib ion, hich ma be d e o he m ch s ronger in erac ion be een P par icles and $CoNiO_2$.

Raman spec ra are f r her sed o charac eri e he modification process and de ec rela ed sca ering peaks. As sho n in Fig. 1B, all he ma erials e hibi o ob io s charac eris ic peaks loca ed a 1348 and 1583 cm^{-1}, hich correspond o he D-band and G-band, respec i el . Generall , he D-band is con rib ed from he ibra ions of sp^3 carbon a oms i h disordered s r c res, and he G-band origina es from he domains of graphi e i h sp^2 carbon a om ibra ions in he composi e s r c res.[35] Speciall , P /$CoNiO_2$–CNTs and $CoNiO_2$–CNTs sho o addi ional peaks a 536 and 664 cm^{-1}, hich are considered o ha e origina ed from he sca ering peaks of $CoNiO_2$ and CoOOH, respec i el .[40,41] The res l s f r her demons ra e ha $CoNiO_2$ is clearl modified on acid- rea ed CNTs.

Morphology characterization and XPS analysis

The morphologies, elemen s, and par icle si e dis rib ions of P /$CoNiO_2$–CNTs are charac eri ed b TEM images and EDS mapping. As sho n in Fig. 2a, he TEM images of P /$CoNiO_2$–CNTs sho ha he par icles of P are ell-dispersed on he $CoNiO_2$ modified acid- rea ed CNT s rface. The par icle si e dis rib ion of P (see Fig. 2b and S1†) ob ained from randoml selec ed 100 par icles sho s ha he a erage par icle si e is 3.1 nm, hich is consis en i h he calc la ed XRD res l s. The high-resol ion TEM image (see Fig. 2c) e hibi s hree differen pes of fringe spacings a abo 0.34, 0.241, and 0.224 nm corresponding o CNTs (002), $CoNiO_2$ (111), and P (111) in erplanar dis ances, respec i el . The EDS spec ra of P /$CoNiO_2$–CNTs (see Fig. S2†) sho s ha he elemen s C, O, Co, Ni, and P are clearl e hibi ed in he arge composi e. Addiionall , as sho n in Fig. 2d–g, he elemen s P , Co, Ni, and O are consis en l dis rib ed hro gho he composi e; his f r her indica es ha he P par icles are ell-dispersed on he arge ed $CoNiO_2$–CNT h brid ma erial.

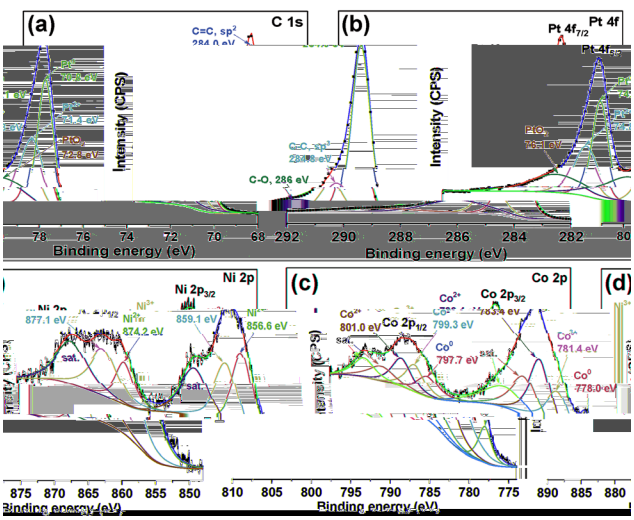


(a) TEM image and (b) particle size distribution of Pt/$CoNiO_2$–CNTs; (c) High-resolution TEM image of Pt/$CoNiO_2$–CNTs; EDS mapping of (d) Pt, (e) Co, (f) Ni, and (g) O for Pt/$CoNiO_2$–CNTs.

The XPS echniq e pro ides informa ion on he composi ion of he ca al s and he corresponding chemical alence s a es of he designa ed composi es. The en ire XPS spec r m is ini iall correc ed b he high-resol ion C 1s spec r m. As sho n in Fig. 3a, he C 1s spec r m is mainl decon ol ed in o hree peaks: 284.0 eV (sp^2 C=C), 284.8 eV (sp^3 C–C), and 286.0 eV (C–O). The f ll-range XPS spec r m of he as-prepared P /$CoNiO_2$–CNTs (see Fig. S3†) sho s ha he ma erial is composed of C, O, P , Ni, and Co. As sho n in Fig. 3b, he high-resol ion P 4f peaks can be decon ol ed in o hree pairs of peaks for P $4f_{7/2}$ (70.8, 71.4, and 72.8 eV) and P $4f_{5/2}$ (74.1, 74.8, and 76.1 eV), in hich he binding energies a 70.8 and 74.1 eV are rela ed o me al P^0, he binding energies a 71.4 and 74.8 eV are ascribed o P^{2+} from P O or $P(OH)_2$, and he binding energies loca ed a 72.8 and 76.1 eV are a rib ed o PO_2.[38,42] As sho n in Fig. 3c, he high-resol ion Co 2p i h Co $2p_{3/2}$ and Co $2p_{1/2}$ peaks in he P /$CoNiO_2$–CNT composi e is obser ed, in hich he binding energies for me al Co^0 are loca ed a 778.0 and 797.7 eV, indica ing ha par ial P Co allo s are formed.[43] The binding energies of he Co^{2+} species are loca ed a 783.4 and 801.0 eV, and hose of he Co^{3+} species are loca ed a 781.4 and 799.3 eV, respec i el .[43] I sho ld be no ed ha here are o o her pairs of peaks a higher binding energies, hich can be considered as sa elli e peaks from cobal (h dro)o ide. The high-resol ion Ni 2p of P /$CoNiO_2$–CNTs is sho n in Fig. 3d, in hich he o rela i el high spike peaks a 856.6 and 874.2 eV are ascribed o he Ni^{2+} o ida ion s a e of Ni $2p_{3/2}$ and Ni $2p_{1/2}$, respec i el .[34] The o her o peaks obser ed a 859.1 and 877.1 eV are ascribed o Ni $2p_{3/2}$ and Ni $2p_{1/2}$ of Ni^{3+}, respec- i el .[44] I is no e or h ha a pair of peaks a high binding energies can be clearl obser ed, hich is deri ed from he shake p sa elli e peaks of nickel (h dro)o ide.

Electrochemical performance analysis

CO-s ripping ol amme r is an effec i e me hod o ele a e he remo al abili of in ermedia es (especiall CO_{ads}), b can also



High-resolution XPS spectrum of (a) C 1s, (b) Pt 4f, (c) Co 2p, and (d) Ni 2p for Pt/$CoNiO_2$–CNTs.

res l s sho ha he ca al ic performance and an i-poisoning abili of o r de eloped h brid ca al s are be er han hose of mos of e er repor ed P -based ca al s s for e hanol elec ro-o ida ion in an alkaline sol ion. More impor an l , as sho n in Fig. 5B, he Tafel slope of P /$CoNiO_2$–CNTs is 205 mV dec^{-1} (similar o ha of he commercial P /C), hich is lo er han ha of P /rGO (422 mV dec^{-1}) and P /CNTs (218 mV dec^{-1}), sho ing m ch fas er reac ion kine ics.[47]

Apar from he elec roca al ic ac i i , long- erm s abili is ano her significan cri erion o e al a e he sef lness of a ca al s . As sho n in Fig. 6, ime-dependen c rren densi ies are in es iga ed in a sol ion of 1.0 M KOH + 0.5 M e hanol for 3600 s a a fi ed po en ial of −0.3 V. I can be seen ha all ca al s s ha e rela i el high ini ial c rren densi ies, hich hen s ffer a rapid recession s age n il he reach rela i el s ead s a es. The higher ini ial c rren densi ies res l from higher e hanol concen ra ions, and he sharp deca is d e o he decrease in he e hanol concen ra ion gradien and he poisoning of he acc m la ed in ermedia e species. I is or h no ing ha he c rren densi of P /$CoNiO_2$–CNTs is signifi-can l higher han ha of he P /rGO and P /CNT ca al s s in he hole process, and he final c rren densi of P /$CoNiO_2$–CNTs (37.7 mg cm^{-1} P) is 55.4- and 2.2-fold higher han ha of P / rGO and P /CNTs, respec i el .

Mechanism discussion

The e cellen elec rochemical ac i i and long- erm s abili of P /$CoNiO_2$–CNTs for e hanol elec ro-o ida ion co ld be ascribed o he s nergis ic effec of he ell-dispersed small P par icles and he $CoNiO_2$-modified CNT s bs ra e. As sho n in Scheme 2, he specific s nergis ic ca al ic process can be nders ood, and he differen s eps can be ded ced as follo s:[5,48]

$$OH^- \rightarrow OH_{ads} + e^- \quad (3)$$

$$CH_3CH_2OH \rightarrow CH_3CH_2OH_{ads} \quad (4)$$

$$CH_3CH_2OH_{ads} + 3OH_{ads} \rightarrow CH_3CO_{ads} + 3H_2O + 3e^- \quad (5)$$

$$CH_3CO_{ads} + OH_{ads} \rightarrow CH_3COOH \quad (6)$$

$$CH_3COOH + OH^- \rightarrow CH_3COO^- + H_2O \quad (7)$$

$$CO_{ads} + OH_{ads} + 3OH^- \rightarrow CO_3^{2-} + 2H_2O + e^- \quad (8)$$

As is ell kno n, he s rface of $CoNiO_2$ carries a nega i e charge nder alkaline condi ions beca se he h dro l gro p (–OH) adsorbs on o he s rface of $CoNiO_2$; his res l s in he forma ion of $CoNiO_2$–OH_{ads} species on he h brid s ppor . Herein, pon con in o sl increasing he po en ials on he anode, he ac i e si es of P on he h brid ca al s ill adsorb he e hanol molec les from he sol ion, and P –$CH_3CH_2OH_{ads}$ species ill be formed. Then, he P –$CH_3CH_2OH_{ads}$ species ill be o idi ed o P

o he s n hesi ed P /$CoNiO_2$–CNT ca al s , and he final prod c s ha e been anal ed b C2 and C1 pa h a s. The s perior elec roca al ic performance of he designed ca al s repor ed herein highligh s an effec i e me hod o achie e l rahigh ca al ic ac i i for e hanol in alkaline media, indica ing po en ial applica ion prospec s of his ca al s in direc alkaline e hanol f el cells.

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There are no conflic s o declare.

I

This ork as s ppor ed b he Na ional Na ral Science Fo nda ion of China (21363003, 21165004, 21163002), Na ral Science Fo nda ion of G ang i Pro ince (2014GXNSFGA118008, 2014GXNSFFA118003), BAGUI scholar program (2014A001), and Projec of Talen s Highland of G ang i Pro ince.

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