Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information:

Intermetallic PdZn Nanoparticles Loaded on Deficient TiO_2 Nanosheet as Support: A Bifunctional Electrocatalyst for Oxygen Reduction in PEMFC and Glycerol Oxidation Reactions

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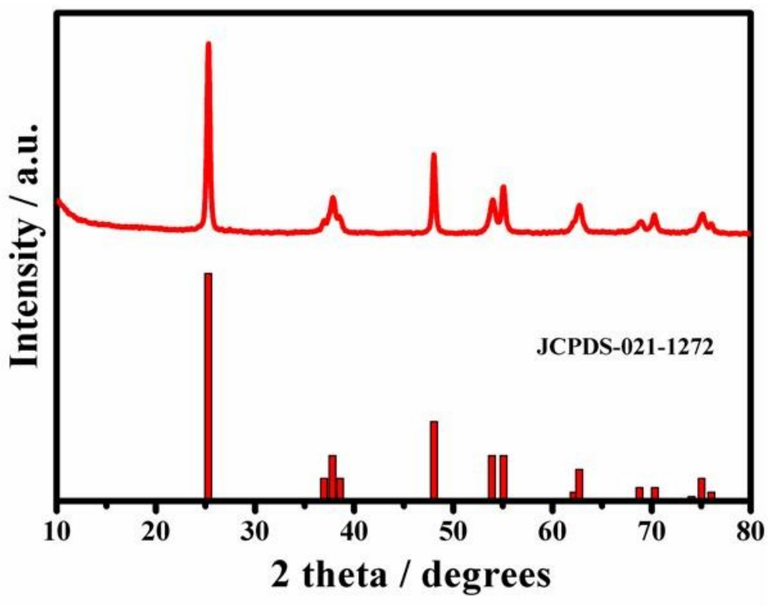

Fig. S1. XRD pattern and its standard pattern of TiO_2 NS (JCPDS-021-1272).

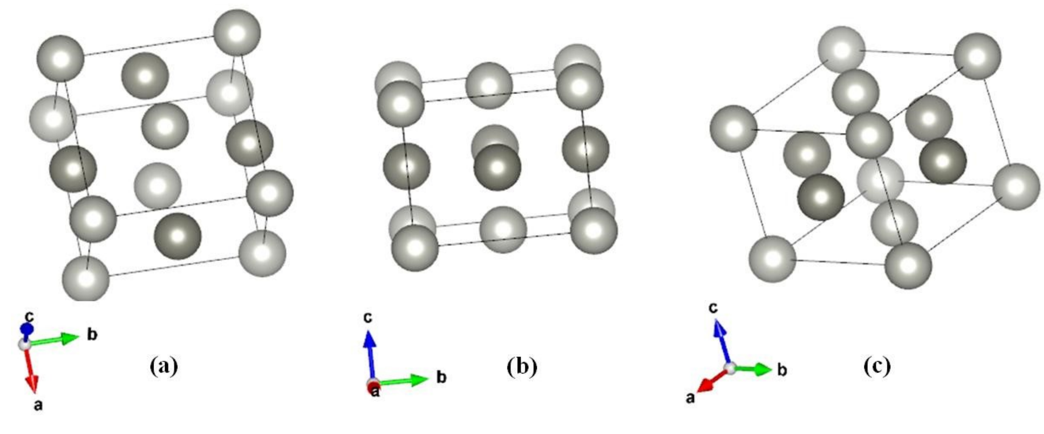

Fig. S2. Crystal structure of PdZn at different angles.

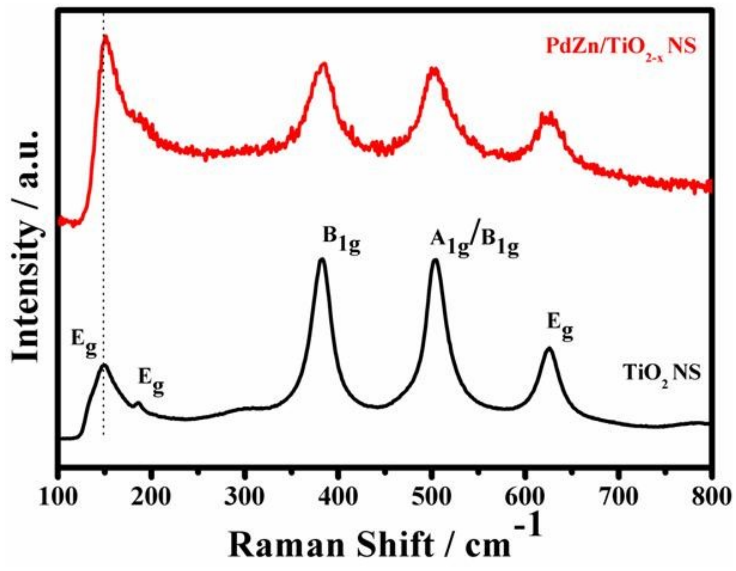

Fig. S3. Raman spectra of TiO_2 NS and PdZn/TiO_{2-x} NS.

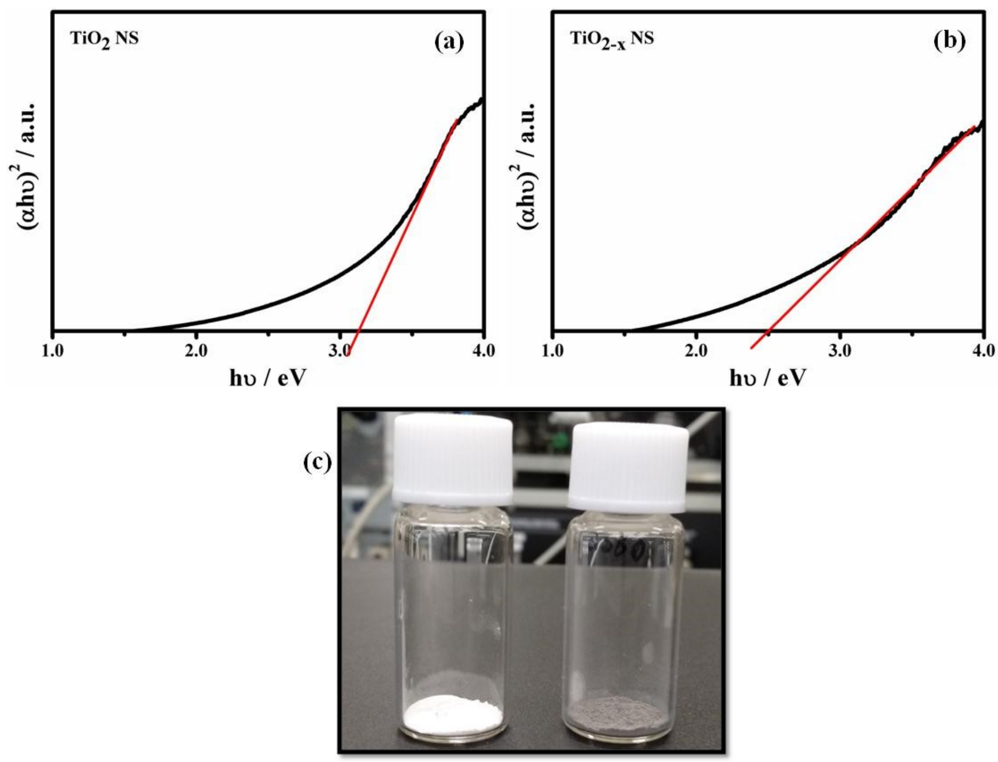

Fig. S4. Tauc plots of (a) TiO_2 NSs and (b) TiO_{2-x} NSs for determining the band gap with the help of UV-vis absorption spectra. (c) Photograph of TiO_2 NSs and TiO_{2-x} NSs powders.

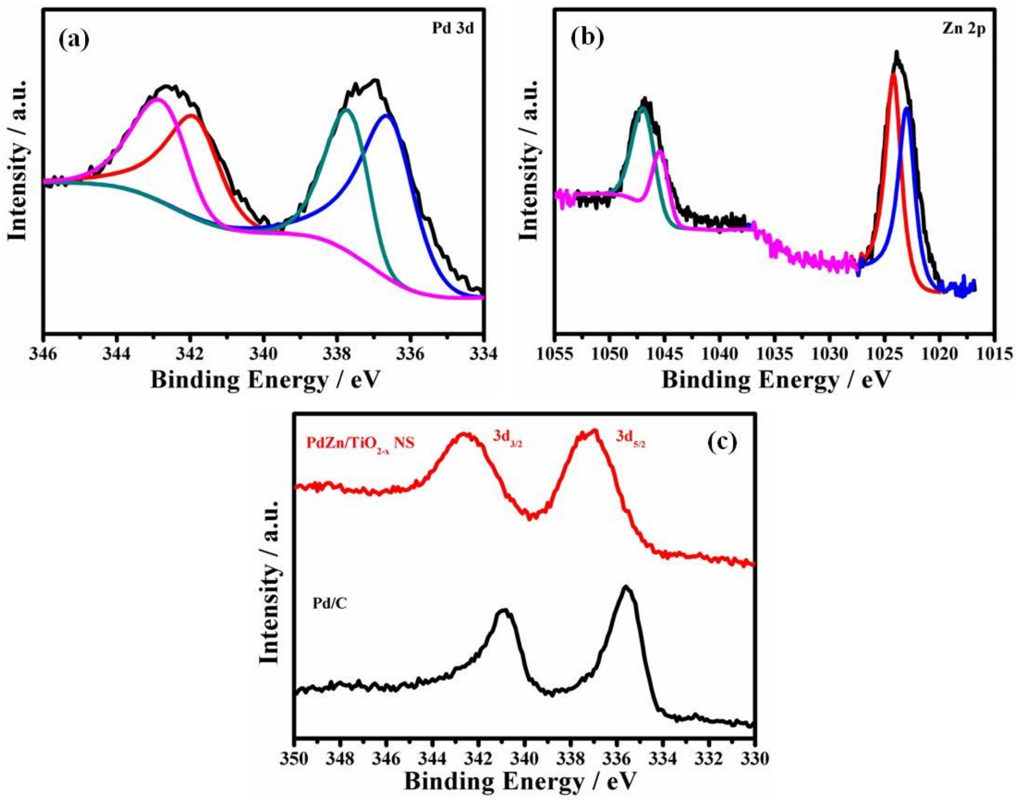

Fig. S5. XPS spectra of (a) Pd 3d, (b) Zn 2p of PdZn/TiO_{2-x} NSs and (c) Pd comparison of PdZn/TiO_{2-x} NSs and Pd/C.

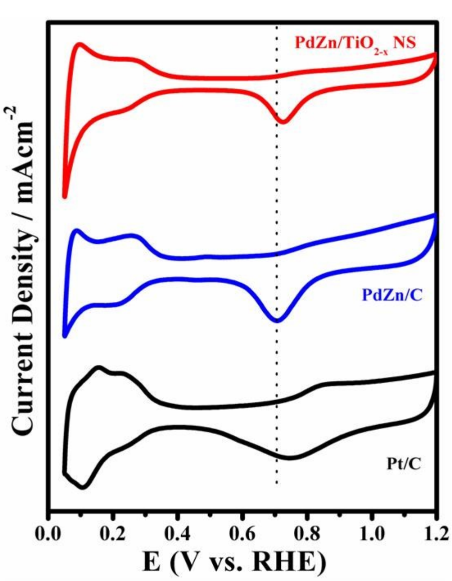

Fig. S6. Cyclic voltammograms of PdZn/TiO_{2-x} NSs, PdZn/C and Pt/C in Ar-saturated 0.1 M $HClO_4$ at 50 mV s^{-1}.

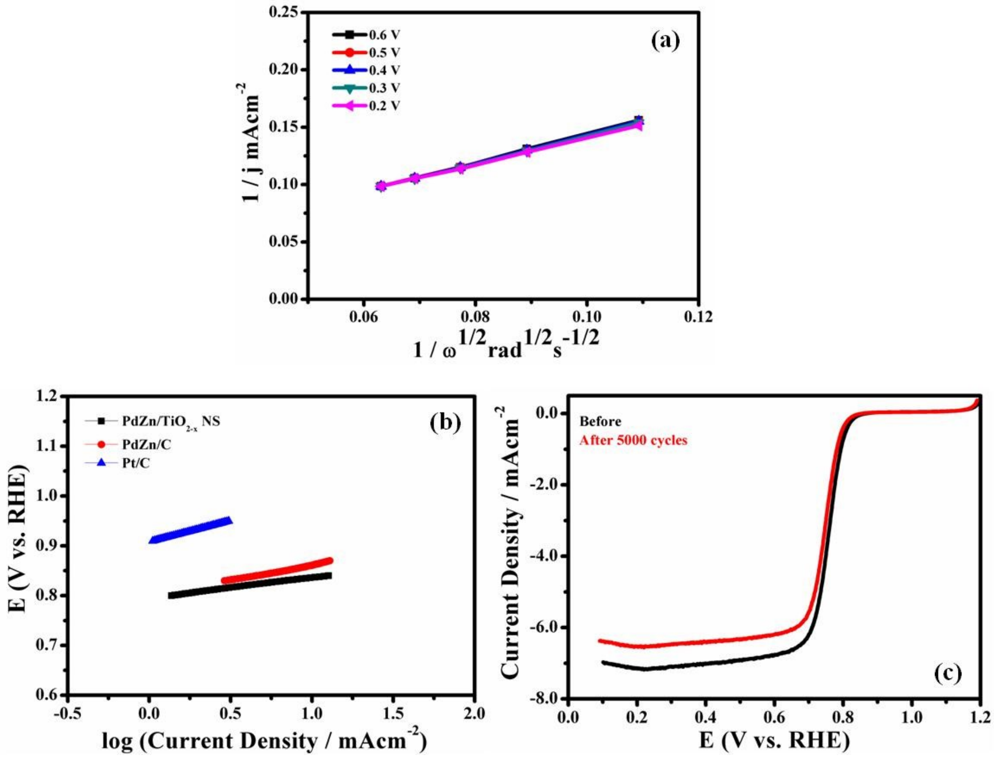

Fig. S7. (a)K-L plots at different potentials of PdZn/C, (b) Tafel plots of PdZn/TiO_{2-x} NSs, PdZn/C and Pt/C electrodes and (c) hydrodynamic voltammograms at 1600 rpm before and after 5000 cycles for PdZn/TiO_{2-x} NS catalyst in O_2-saturated 0.1 M $HClO_4$.

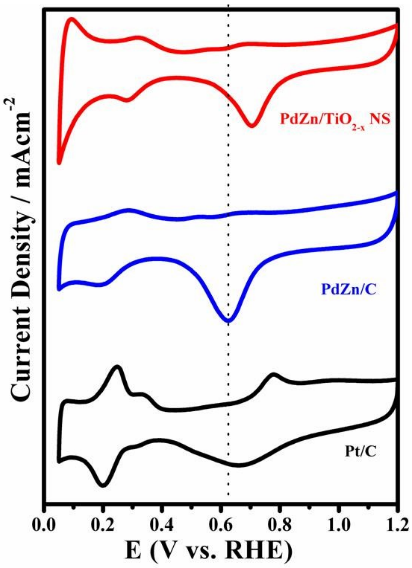

Fig. S8. Cyclic voltammograms of PdZn/TiO_{2-x} NSs, PdZn/C and Pt/C in Ar saturated 1.0 M KOH.

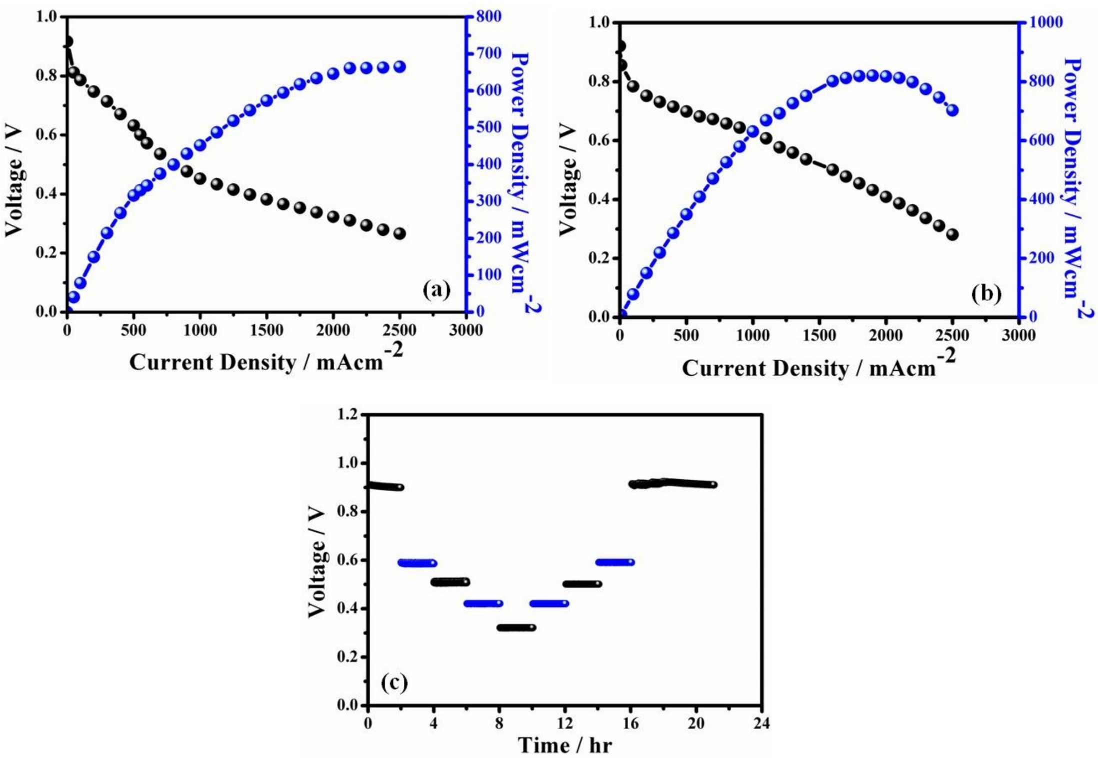

Fig. S9. polarization - discharge power density curves as function of current density plots of PdZn/C(a) and (b) Pt/C as the cathode and (c) durability test according to the voltage along with time at different current densities method for H_2-O_2 PEMFC with PdZn/TiO_{2-x} NS as the cathode at 80 °C.

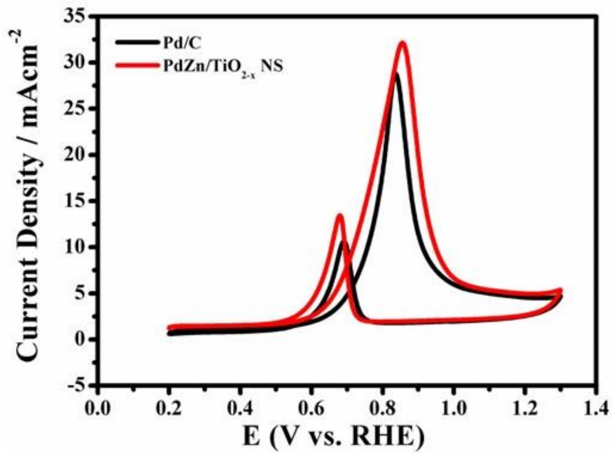

Fig. S10. Cyclic voltammograms of PdZn/TiO_{2-x} NS and Pd/C catalysts in (0.5 M glycerol + 1.0 M KOH) solution.

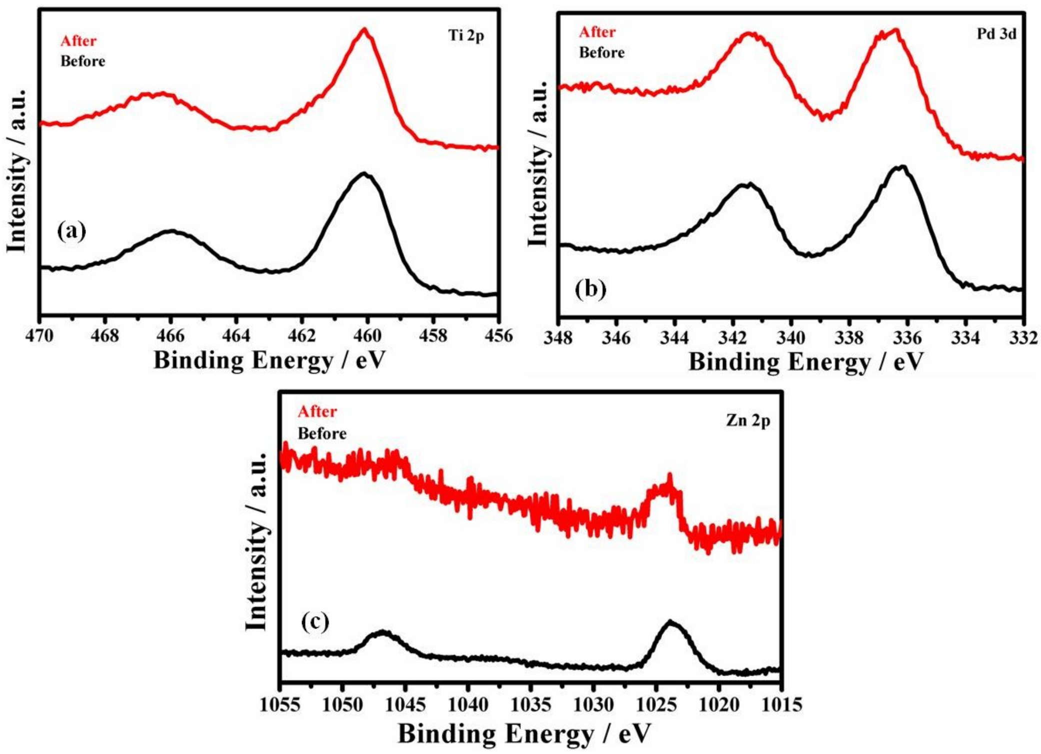

Fig. S11. High resolution XPS spectra of (a) Ti 2p, (b) Pd 3d and (c) Zn 2p of PdZn/TiO_{2-x} NSs before and after GOR electrolysis in (0.5 M glycerol + 1.0 M KOH) solution at 30 ºC.

Table S1

Comparison of electrochemical performances of the different electrocatalysts for oxygen reduction reaction

Catalysts	Onset potential vs RHE in V		$E_{1/2}$ vs RHE in V		References
Pd_3Co/C	H_2SO_4	-	H_2SO_4	0.788	[1]
$Au_{67}Pd_{33}/CN$	KOH	0.94	KOH	0.83	[2]
Pd/CNS-20%	KOH	0.96	KOH	0.82	[3]
PdCuPt	$HClO_4$	0.93	$HClO_4$	0.86	[4]
Pd@PdO-Co_3O_4	KOH	0.92	KOH	0.77	[5]
Pd_3Fe NPs/CB	KOH	0.87	KOH	0.80	[6]
Pd_3Ni NPs/CB	KOH	0.90	KOH	0.81	[6]
Pd/FHNC	$HClO_4$	0.82	$HClO_4$	0.61	[7]
PdZn/TiO_{2-x} NS	$HClO_4$	0.88	$HClO_4$	0.76	Present work
	KOH	0.94	KOH	0.834	

Table S2

Comparison for the fuel cell performance and its power densities of different cathode materials

Anode/loading in mg cm^{-2}	**Cathode/loading in mg cm^{-2}**	**Power Density in mW cm^{-2}**	**Temperature in °C**	**References**
Pt/C (0.2)	fct-FePt/C (0.2)	~ 850	80	[8]
Pt/C (0.4)	$PtPd/TiO_2$ (0.4)	520	75	[41] Main manuscript
Pt/C (0.4)	CNT-Pt/TiO_2 (0.4)	567	75	[42] Main manuscript
Pt/C (0.2)	PANI-Fe-NCS (0.4)	830	80	[9]
Pt/C (0.25)	Pt_3Co-N-(G-MWNTs) (0.4)	935	60	[10]
Pt/C (0.25)	Pt_3Fe-N-(G-MWNTs)(0.24)	783	60	[10]
Pt/C (0.1)	Pd-Co/gCN (0.5)	190	60	[45] Main manuscript
Pt/C (0.32)	$RuTe_2/C$ (0.26)	269	55	[46] Main manuscript
Pt/C (0.231)	Pt_3Co/C (0.143)	863	80	[47] Main manuscript
Pt/C (0.2)	$PdZn/TiO_{2-x}$ NS (0.3)	855	80	Present work

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