Supporting Information

PtCu Nanoparticle Catalyst for Electrocatalytic Glycerol Oxidation: How Does the PtCu Affect to Glycerol Oxidation Reaction Performance by Changing pH Conditions?

Lee Seul Oh [1, 2], Jeonghyun Han [3], Eunho Lim [1], Won Bae Kim [3, *] and Hyung Ju Kim [1, 4, *]

[1] Chemical & Process Technology Division, Korea Research Institute of Chemical Technology (KRICT), 141 Gajeong-ro, Yuseong-gu, Daejeon 34114, Republic of Korea; seul1030@krict.re.kr (LSO); eunho-lim@krict.re.kr (EL); hjkim@krict.re.kr (HJK)

[2] Department of Chemical and Biomolecular Engineering, Yonsei University, 50 Yonsei-ro, Seodae-mun-gu, Seoul 03722, Republic of Korea

[3] Department of Chemical Engineering Pohang University of Science and Technology (POSTECH), 77 Cheongam-ro, Nam-gu, Pohang-si, Gyeongsangbuk-do 37673, Republic of Korea; hjhyeon95@postech.ac.kr (JH); kimwb@postech.ac.kr (WBK)

[4] Advanced Materials and Chemical Engineering, University of Science and Technology (UST), 113 Gwahangno, Yuseong-gu, Daejeon 34113, Republic of Korea

[*] Correspondence: kimwb@postech.ac.kr (WBK); hjkim@krict.re.kr (HJK)

Keywords: electrocatalytic glycerol oxidation; PtCu electrocatalyst; pH condition change; catalytic activity enhancement; reaction pathway control

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LSV curves of the Pt/C and PtCu/C with increasing pH

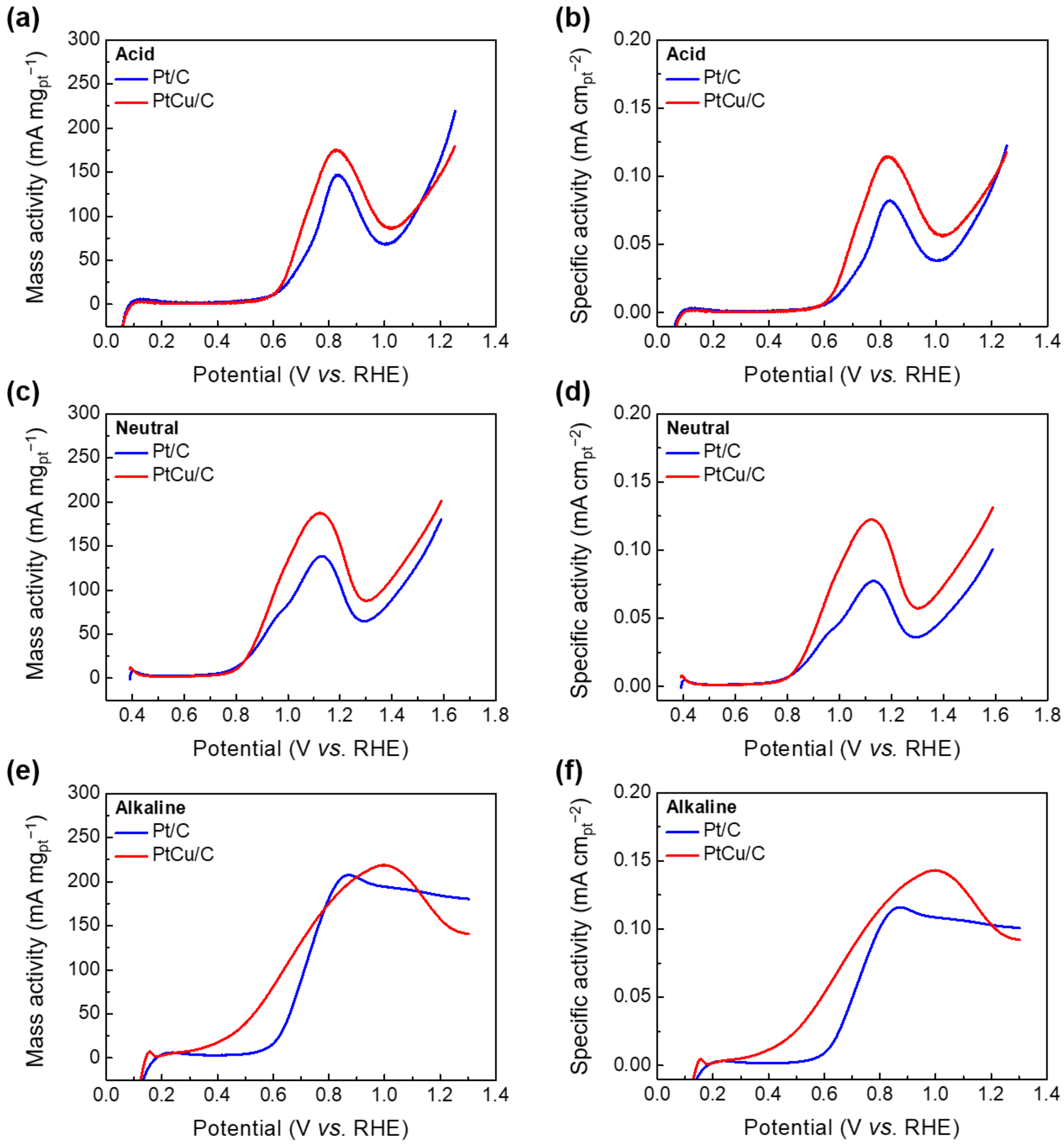

Figure S1. LSV curves of the Pt/C and PtCu/C catalysts in 1 M glycerol (**a**,**b**) with 0.5 M H_2SO_4, (**c**,**d**) with 0.1 M Na_2SO_4, and (**e**,**f**) with 0.1 M KOH electrolyte (scan rate: 5 mV s^{-1} at room temperature). Figures (**a**,**c**,**e**) represent mass activity and Figures (**b**,**d**,**f**) show specific activity, respectively.

Comparison of the Tafel slope with increasing pH

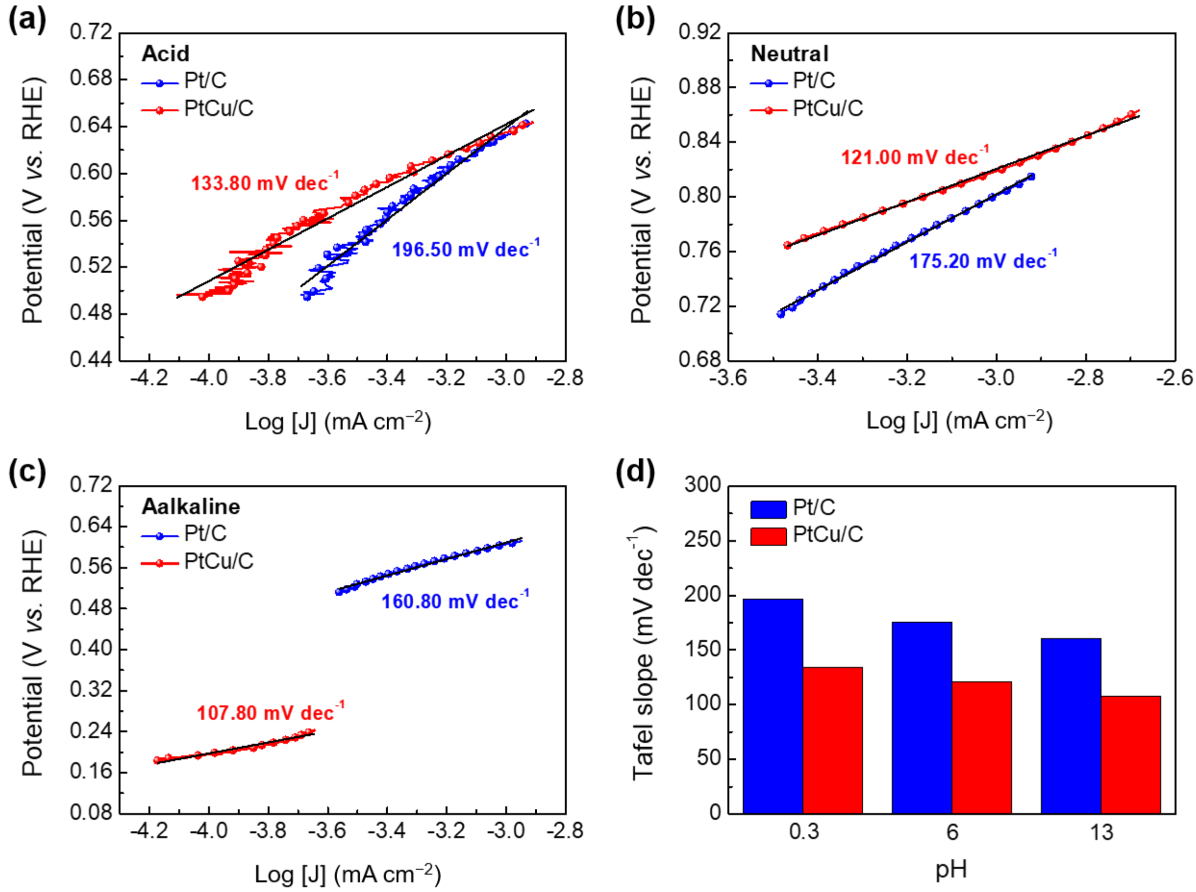

Figure S2. Tafel plot of the Pt/C and PtCu/C catalysts in 1 M glycerol with (**a**) 0.5 M H_2SO_4 (acid), (**b**) 0.1 M Na_2SO_4 (neutral), and (**c**) 0.1 M KOH (alkaline). (**d**) Comparison of the Tafel slope with increasing pH.

Comparison table of EGOR performances using Pt-based catalysts

Table S1. Comparison table of EGOR performances using Pt-based catalysts.

Catalyst	Feed Solution	Scan Rate (mV s^{-1})	Electrocatalytic Glycerol Oxidation		Ref.
			Mass Activity (mA mg_{Pt}^{-1})^{a}	Specific Activity (mA cm_{Pt}^{-1})^{b}	
PtRuSn/C	2 M glycerol + 0.5 M H_2SO_4	50	253.2	-	[1]
$Pt_{0.85}Cu_{0.15}$-CuO(3)/C	0.1 M glycerol+ 0.1 M NaOH	50	270	-	[2]
Co@Pt/CCE	0.5 M glycerol + 0.5 M H_2SO_4	50	-	0.25	[3]
PtAu@Ag	1 M glycerol + 0.1 M $HClO_4$	10	-	0.27	[4]
Pt/3D-GLC	2 M glycerol + 0.5 M H_2SO_4	50	178.2	-	[5]
ALD(TiO_2)-Pt/C(150HT)	2 M glycerol + 0.5 M H_2SO_4	50	186	0.25	[6]
Sn@Pt/C	0.5 M glycerol + 0.5 M H_2SO_4	20	56	-	[7]
Rh@Pt/C	0.5 M glycerol + 0.5 M H_2SO_4	20	93	-	
75ALD(SnO_2)-Pt/C(HT)	2 M glycerol + 0.5 M H_2SO_4	50	-	0.43	[8]
Pt nanoflowers	1 M glycerol + 0.5 M H_2SO_4	50	180	0.32	[9]
PtNi/C	2 M glycerol + 0.5 M H_2SO_4	50	204	0.27	[10]
PtCu/C	1 M glycerol + 0.5 M H_2SO_4	50	156.20	0.34	This work
	1 M glycerol+ 0.1 M Na_2SO_4	50	163.20	0.36	
	1 M glycerol+ 0.1 M KOH	50	199.80	0.44	

References

1. Kim, H.J.; Choi, S.M.; Green, S.; Tompsett, G.A.; Lee, S.H.; Huber, G.W.; Kim, W.B. Highly active and stable PtRuSn/C catalyst for electrooxidations of ethylene glycol and glycerol. *Appl. Catal. B* **2011**, *101*, 366-375, doi:10.1016/j.apcatb.2010.10.005.
2. Sieben, J.M.; Alvarez, A.E.; Sanchez, M.D. Glycerol electrooxidation on carbon-supported Pt-CuO and PtCu-CuO catalysts. *Electrochim. Acta.* **2023**, *439*, doi:10.1016/j.electacta.2022.141672.
3. Habibi, B.; Ghaderi, S. Synthesis, characterization and electrocatalytic activity of Co@Pt nanoparticles supported on carbon-ceramic substrate for fuel cell applications. *Int. J. Hydrog. Energy* **2015**, *40*, 5115-5125, doi:10.1016/j.ijhydene.2015.02.103.
4. Zhou, Y.; Shen, Y.; Xi, J. Seed-mediated synthesis of PtxAuy@Ag electrocatalysts for the selective oxidation of glycerol. *Appl. Catal. B* **2019**, *245*, 604-612, doi:10.1016/j.apcatb.2019.01.009.
5. Lee, D.; Kim, Y.; Kwon, Y.; Lee, J.; Kim, T.-W.; Noh, Y.; Kim, W.B.; Seo, M.H.; Kim, K.; Kim, H.J. Boosting the electrocatalytic glycerol oxidation performance with highly-dispersed Pt nanoclusters loaded on 3D graphene-like microporous carbon. *Appl. Catal. B* **2019**, *245*, 555-568, doi:10.1016/j.apcatb.2019.01.022.
6. Han, J.; Kim, Y.; Jackson, D.H.K.; Chang, H.; Kim, H.W.; Lee, J.; Kim, J.-R.; Noh, Y.; Kim, W.B.; Lee, K.-Y.; et al. Enhanced catalytic performance and changed reaction chemistry for electrochemical glycerol oxidation by atomic-layer-deposited Pt-nanoparticle catalysts. *Appl. Catal. B* **2020**, *273*, doi:10.1016/j.apcatb.2020.119037.
7. Pupo, M.M.S.; López-Suárez, F.E.; Bueno-López, A.; Meneses, C.T.; Eguiluz, K.I.B.; Salazar-Banda, G.R. Sn@Pt and Rh@Pt core–shell nanoparticles synthesis for glycerol oxidation. *J Appl Electrochem* **2014**, *45*, 139-150, doi:10.1007/s10800-014-0757-0.
8. Lee, D.; Kim, Y.; Han, H.; Kim, W.B.; Chang, H.; Chung, T.-M.; Han, J.H.; Kim, H.W.; Kim, H.J. Atomic-layer-deposited SnO2 on Pt/C prevents sintering of Pt nanoparticles and affects the reaction chemistry for the electrocatalytic glycerol oxidation reaction. *J. Mater. Chem. A* **2020**, *8*, 15992-16005, doi:10.1039/d0ta02509g.
9. Zuo, Y.; Wu, L.; Cai, K.; Li, T.; Yin, W.; Li, D.; Li, N.; Liu, J.; Han, H. Platinum Dendritic-Flowers Prepared by Tellurium Nanowires Exhibit High Electrocatalytic Activity for Glycerol Oxidation. *ACS Appl. Mater. Interfaces* **2015**, *7*, 17725-17730, doi:10.1021/acsami.5b03826.
10. Lee, S.; Kim, H.J.; Choi, S.M.; Seo, M.H.; Kim, W.B. The promotional effect of Ni on bimetallic PtNi/C catalysts for glycerol electrooxidation. *APPL CATAL A-GEN* **2012**, *429-430*, 39-47, doi:10.1016/j.apcata.2012.04.002.