Supplementary Information (SI) for Sustainable Energy & Fuels.

In-Situ Metal Exsolution Induced Structural Transformation Enhances Activity of Pd-Sn Catalyst for the Electrocatalytic Ethanol Oxidation

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Figures

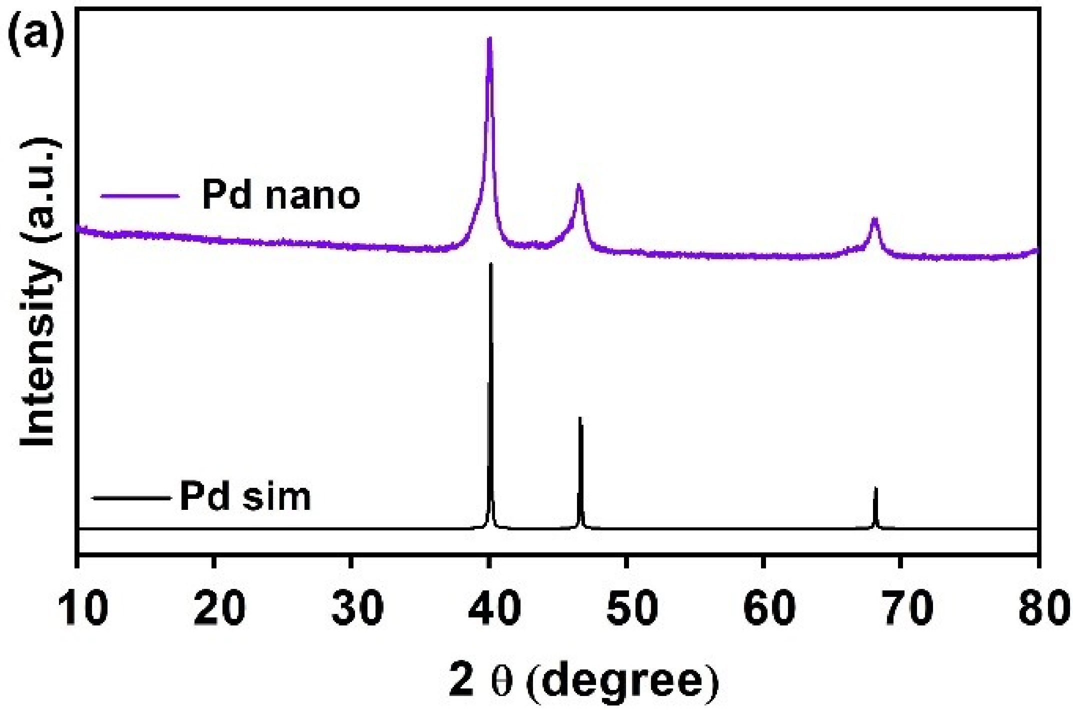

Figure S1. *pXRD patterns of synthesized Pd nanoparticles (Pd nano) compared with simulated pattern of Pd.*

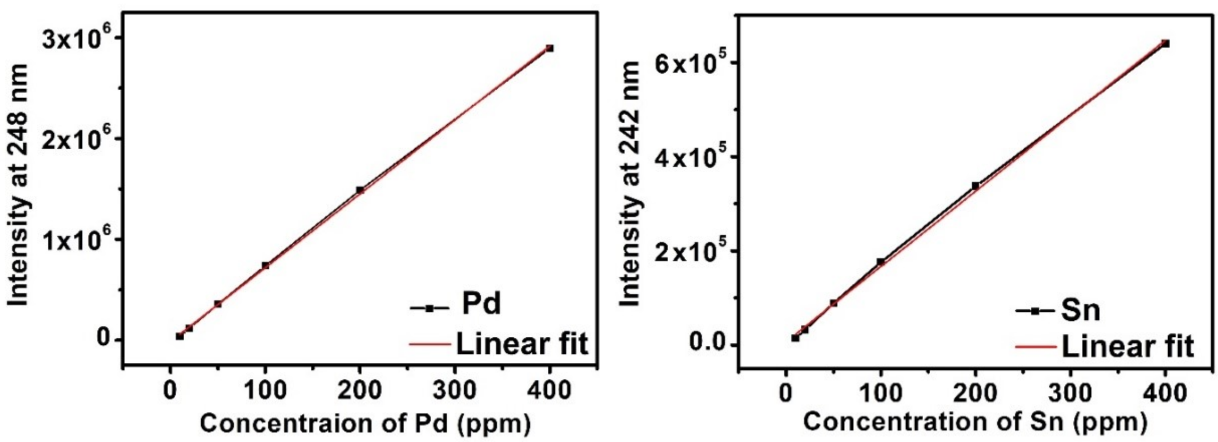

Figure S2. *ICP calibration curves of a) Pd b) Sn*

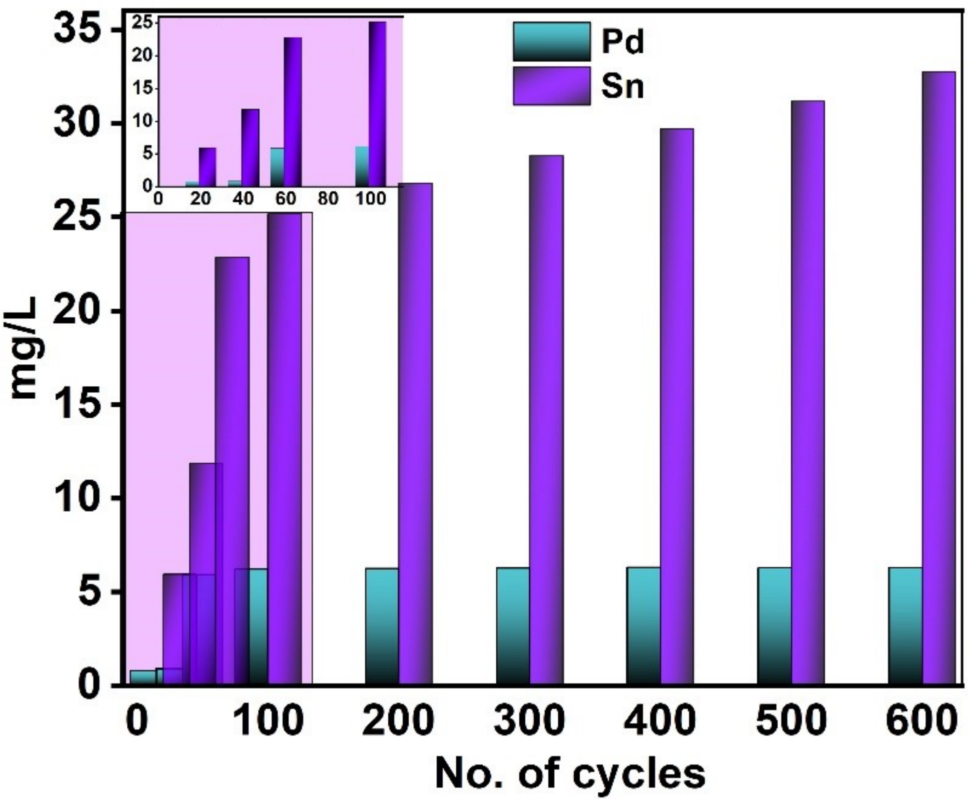

Figure S3. *ICP analysis of the electrolyte after different CV cycles.*

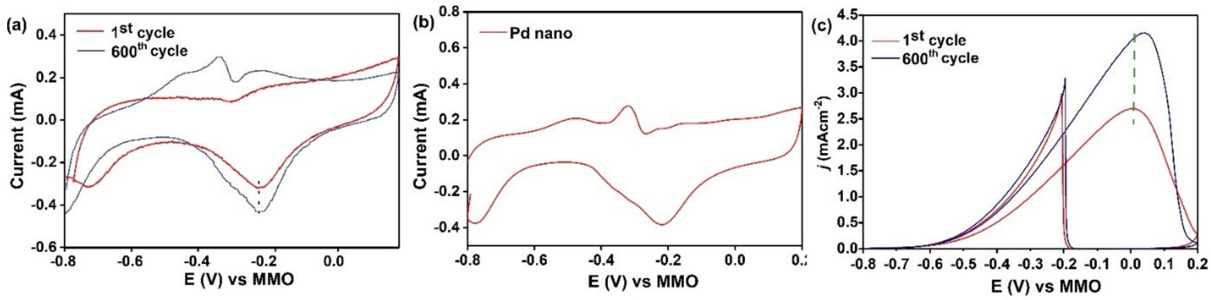

Figure S4. *Cyclic voltammogram obtained in 1M KOH a) for* $Pd_{1.5}Sn_{0.5}$ *catalyst b) Pd nano c) for* $Pd_{1.5}Sn_{0.5}$ *catalyst in 1M KOH + 1M ethanol*

List of Tables

Table S1. Ethanol oxidation performance comparison of Pd- Sn-based materials reported in the literature.

SI No.	Catalyst	Electrolyte	Mass activity/ Specific activity	Increment in activity compared to Pd/C	Maximum no. of CV cycles with out activity loss	Ref.
1.	$Pd_{1.5}Sn$/f-C	1M NaOH+1M C_2H_5OH	3413.3 $mA\ mg_{Pd}^{-1}$	9.6	30	[1]
2.	PdSn-SnO_2/C	1M NaOH+1M C_2H_5OH	68.71 $mA\ cm^{-2}$	2.4	NA	[2]
3.	C-PdSn/SnO_x	1M KOH+1M C_2H_5OH	3.2 $A\ mg_{Pd}^{-1}$	3.2	1000	[3]
4.	Pd_2Sn-NanoR/C	0.5M KOH+0.5M C_2H_5OH	45.6 $mA\ cm^{-2}$	NA	NA	[4]
5.	$Pd_{72}Sn_{28}$	1M KOH+1M C_2H_5OH	2701 $mA\ mg_{Pd}^{-1}$	2.1	Declines	[5]
6.	Pd-Sn NSDs	1M KOH+1M C_2H_5OH	576 $mAmg_{Pd}^{-1}$	1.3	NA	[6]
7.	$Pd_{86}Sn_{14}$/C	0.5M KOH+0.5M C_2H_5OH	8.4 $mA\ cm^{-2}$	3.1	NA	[7]
8.	$Pd_{20}Sn_{24}$	1M KOH+1M C_2H_5OH	2018 $mA\ mg_{Pd}^{-1}$	3.2	39	[8]
9.	PdSn-15(50:50)	1M KOH+1M C_2H_5OH	2230 $mA\ mg_{Pd}^{-1}$	NA	10	[9]
10.	PdSn/C	1M KOH+1M C_2H_5OH	47 $mA\ \ mg_{Pd}^{-1}$	3.9	NA	[10]
11.	PdSn NNWs-3	1M KOH+1M C_2H_5OH	14.1 $mA\ cm^{-2}$	4.9	Declines	[11]
12.	PdSn(50:50)/C	1M KOH+1M C_2H_5OH	0.0035 $mA\ cm^{-2}$	1.4	NA	[12]
13.	Pt@PdSn–SnO_2/C	0.5M H_2SO_4 +0.5M C_2H_5OH	336 $mA\ mg_{Pd}^{-1}$	NA	NA	[13]
14.	PdSn@NP-2	1M KOH+1M C_2H_5OH	2463.8 $mA\ mg_{Pd}^{-1}$	3.5	NA	[14]
15.	$Pd_1Sn_{0.40}$/TiO_2-GO	1M NaOH+1M C_2H_5OH	3000 $mA\ mg_{Pd}^{-1}$	NA	NA	[15]
16.	PdSn/MWCNT	1M KOH+1M C_2H_5OH	20 A g_{Pd}^{-1}	1.3	NA	[16]
17.	SS Cu–PdSn WNWs	0.1M KOH+1M C_2H_5OH	1.03 $A\ mg_{Pd}^{-1}$	2.1	Declines	[17]
18.	$Pd_{5.0}Sn$/CNT	1M NaOH+1M C_2H_5OH	3434 $A\ mg_{Pd}^{-1}$	5.5	NA	[18]
19.	O-Pd_2Sn/C	0.5M KOH+0.1M C_2H_5OH	12.68 $mA\ cm^{-2}$	1.7	NA	[19]
20.	PdSn nanodentrites	1M KOH+1M C_2H_5OH	8.0 m^2g^{-1}	2.9	Declines	[20]
21.	Pd4Sn6- PEDOT	1M KOH+1M C_2H_5OH	15 $mA\ cm^{-2}$	1.6	Declines	[21]
22.	$Pd_{1.84}Sn$@SnO_x	1M KOH+1M C_2H_5OH	6.8 $mA\ cm^{-2}$	3.4	1500	[22]
23.	$PdSn_{0.87}$	1M KOH+1M C_2H_5OH	10.77 mA cm^{-2}	4.14	NA	[23]
24.	PdSn NSA	1M KOH+1M C_2H_5OH	1598 mA cm^{-2}	2.3	20	[24]
25.	Ultrafine $Sn_{18}Pd_{82}$	1M KOH+1M C_2H_5OH	5.7 mA cm^{-2}	2.2	NA	[25]

26.	**$Pd_{1.5}Sn_{0.5}$**	**1M KOH+1M C_2H_5OH**	**4.3** $mA\ cm^{-2}$	**2.0**	**1000**	**This work**

$Pd_{1.5}Sn_{0.5}$ **Catalyst**	**Atomic Ratio**	
	Pd	**Sn**
Pre- EOR	1.5	0.65
Post- EOR	0.90	0.10

Table S2. The comparison of ICP analysis of the catalyst before and after EOR

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