Electronic Supplementary Information

Porous carbon-supported PtPdCu alloy heterostructure with three-dimensional spatial network for efficient ethanol eletro-oxidation

Guanjun Chen[a,*], Yichu Lei[a], Zheming Huang[a], Tong Wang[a], Tingwei Hu,[b,*] Lan Sun[c,*], Yongpeng Qiao[d]

[a] *School of Materials Science and Engineering, Shaanxi University of Science and Technology, Xi'an, 710021, China*

[b] *School of Tropical Medicine,Hainan Medical University, Haikou, 571199, People's Republic of China*

[c] *China Aerodynamic Research and Development Center, Mianyang, 621000, China*

[d] *Xi'An Flit Heat Treatment Co. Ltd, Xi'an, 710075, China*

**Corresponding author:*

sk-cgj@sust.edu.cn (G. J. Chen);

htingwei1236@mail.xjtu.edu (T. W. Hu);

sunlan716@outlook.com (L. Sun).

Fig. S1 Guanjun Chen *et al*.

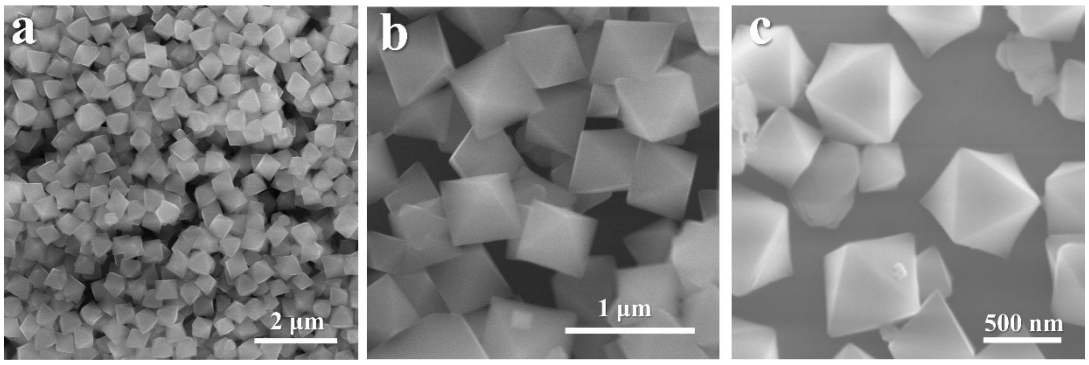

Fig. S1 SEM image of Cu-BTC.

Fig. S2 Guanjun Chen *et al*.

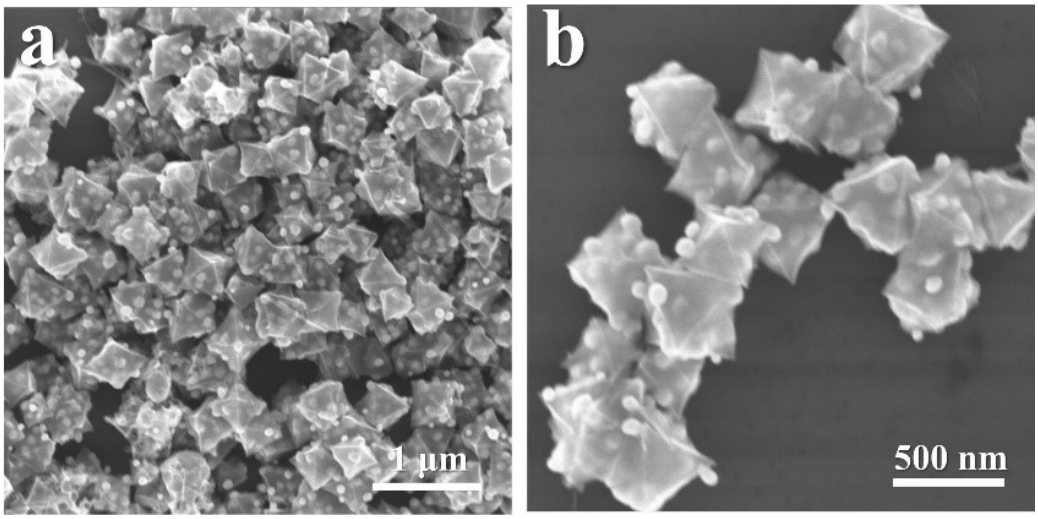

Fig. S2 SEM images of Cu/C.

Fig. S3 Guanjun Chen *et al*.

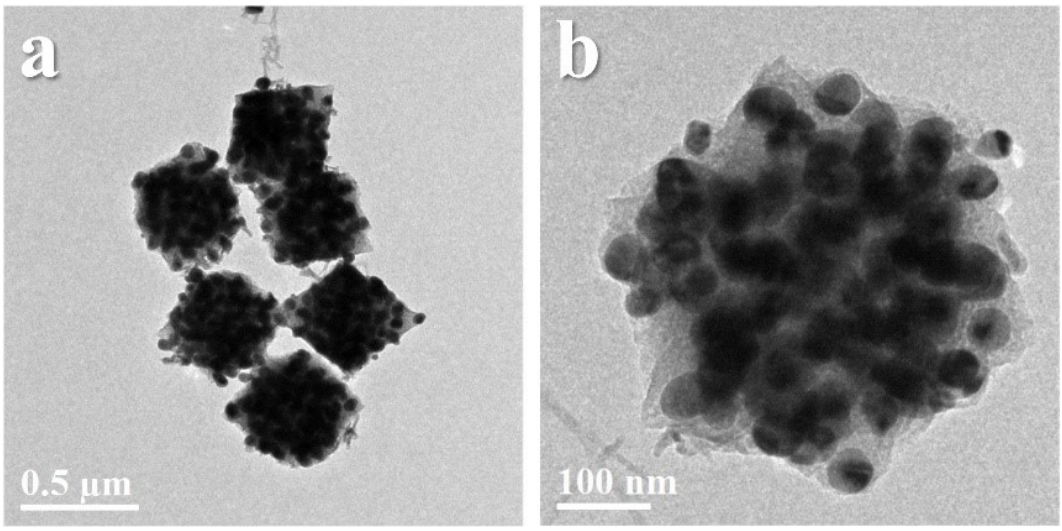

Fig. S3 TEM images of Cu/C.

Fig. S4 Guanjun Chen *et al*.

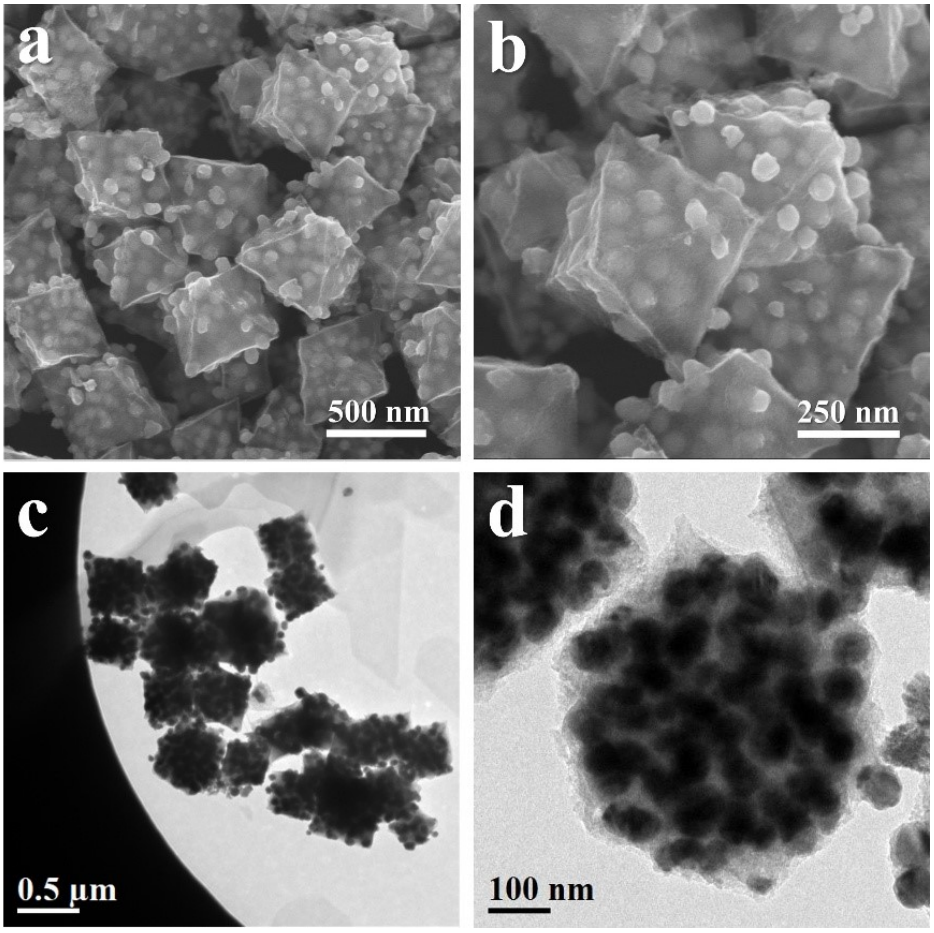

Fig. S4 (a-b) SEM images and (c-d) TEM images of Cu_2O/C.

Fig. S5 Guanjun Chen *et al*.

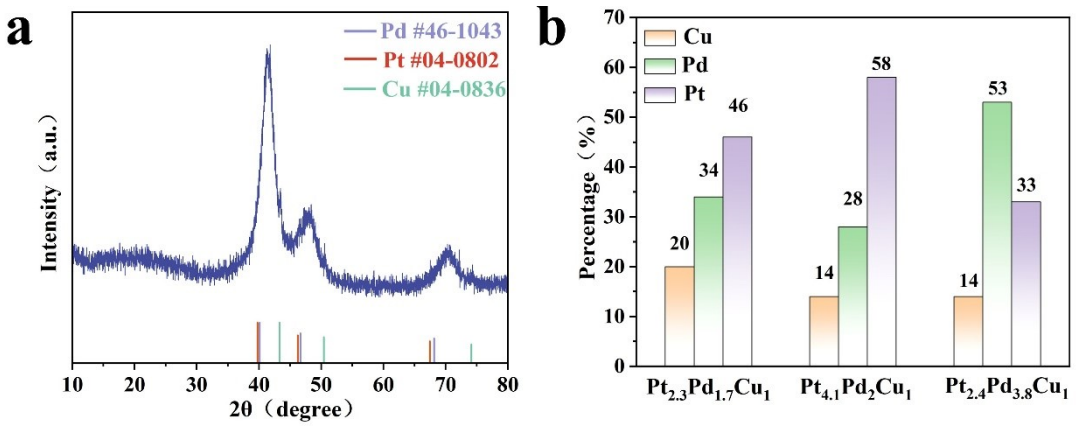

Fig. S5 (a) XRD pattern of $Pt_xPd_yCu_z$/C. (b) The atomic fraction of Pt, Pd and Cu in the sample.

Fig. S6 Guanjun Chen *et al*.

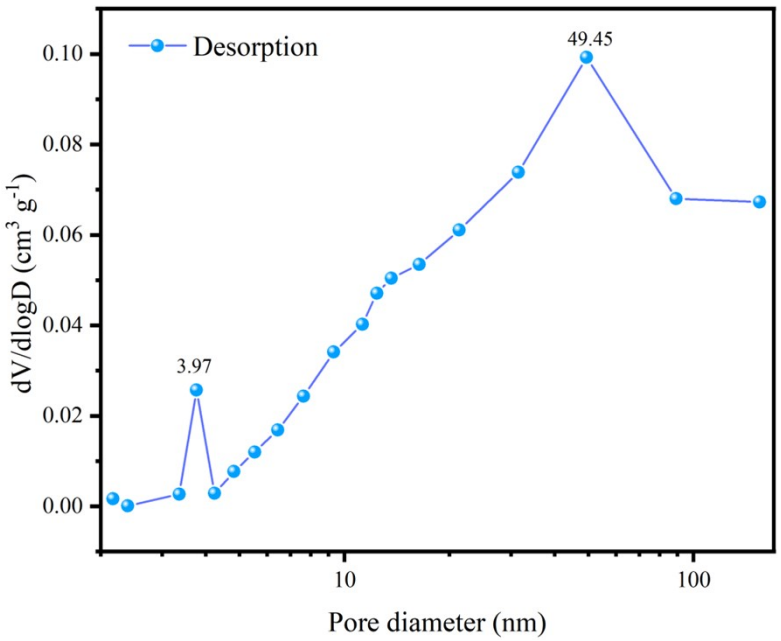

Fig. S6 Nitrogen adsorption and desorption isotherms of $Pt_xPd_yCu_z$/C.

Fig. S7 Guanjun Chen *et al*.

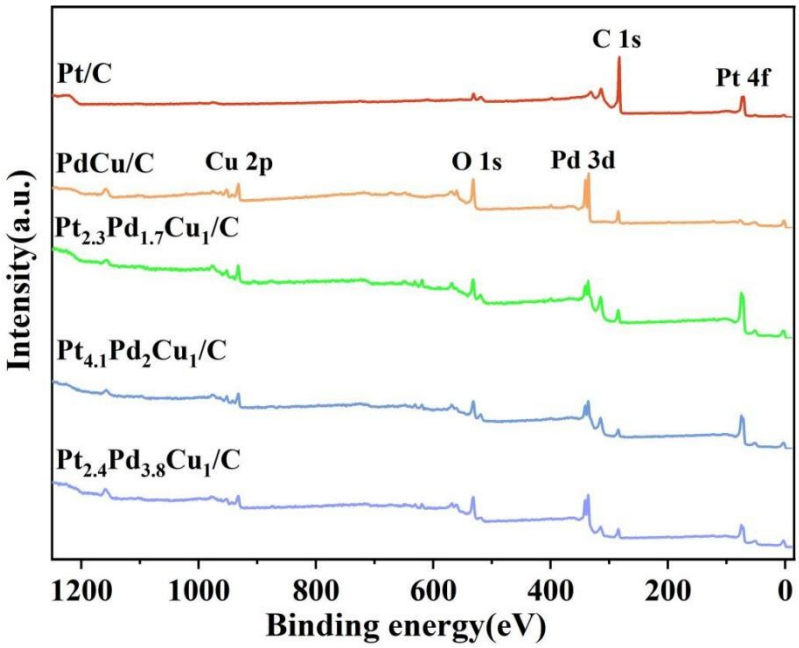

Fig. S7（a-e）Full range XPS spectrum of $Pt_xPd_yCu_z/C$, Pt/C and Pd/C.

Fig. S8 Guanjun Chen *et al*.

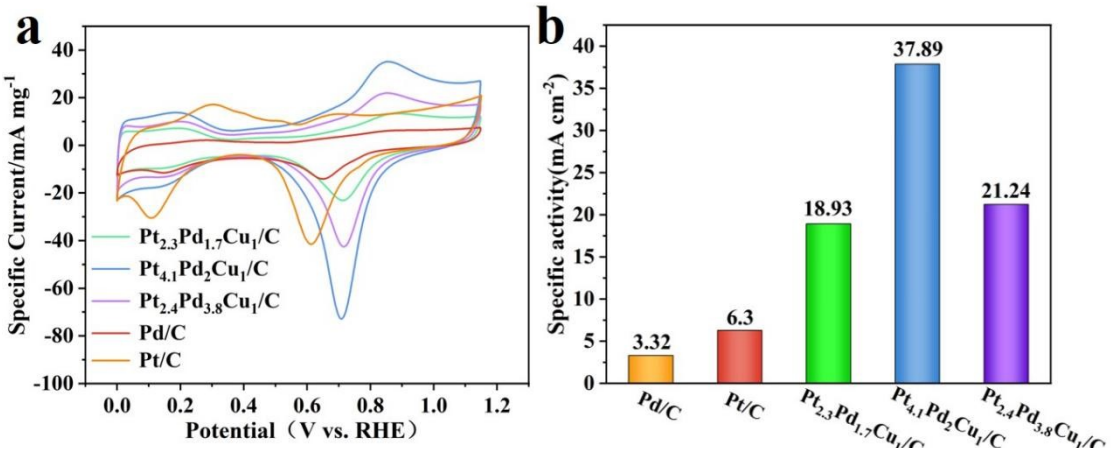

Fig. S8 (a) CV curves of $Pt_xPd_yCu_z/C$, commercial Pt/C and Pd/C catalysts in 1 M KOH. (b) Specific activity of $Pt_xPd_yCu_z/C$, commercial Pt/C and Pd/C catalysts.

Fig. S9 Guanjun Chen *et al*.

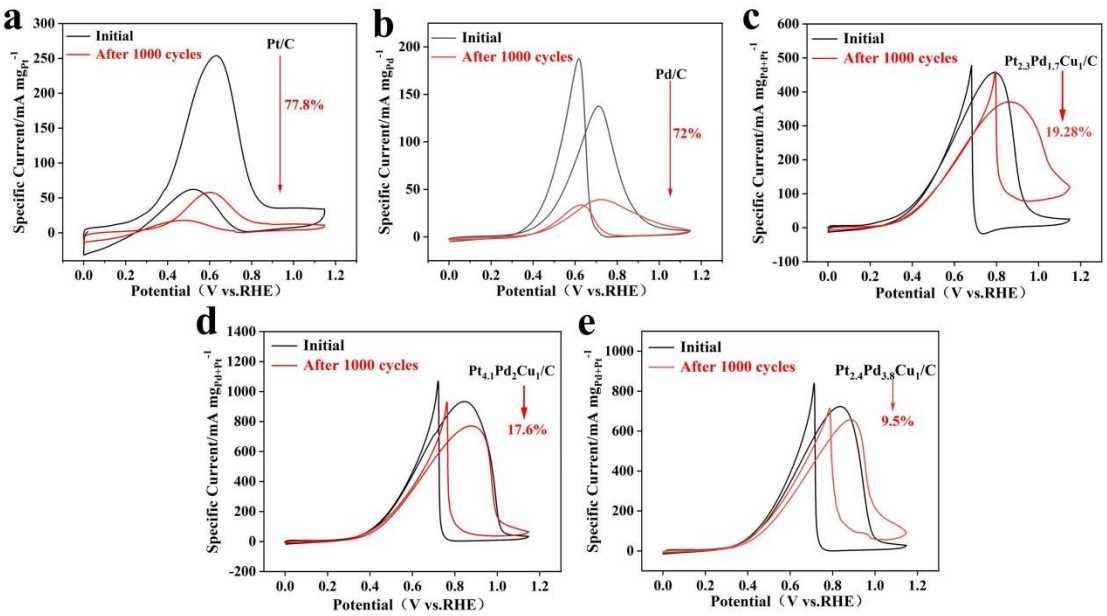

Fig. S9 (a-e) CV curves of Pt/C, Pd/C and $Pt_xPd_yCu_z$/C catalysts before and after 1000 cycles in 1M KOH with 1 M ethanol solution.

Fig. S10 Guanjun Chen *et al*.

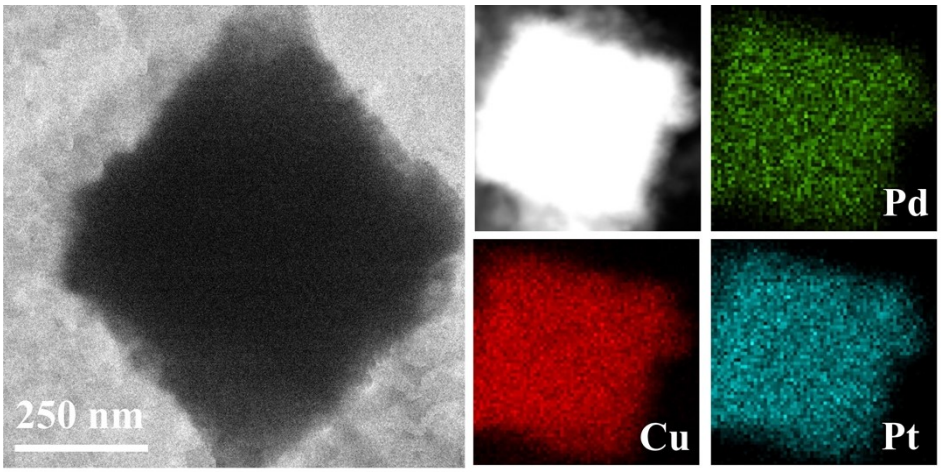

Fig. S10 TEM image and corresponding EDS elemental mapping analysis of PtxPdyCuz/C after electrochemical stability testing.

Fig. S11 Guanjun Chen *et al*.

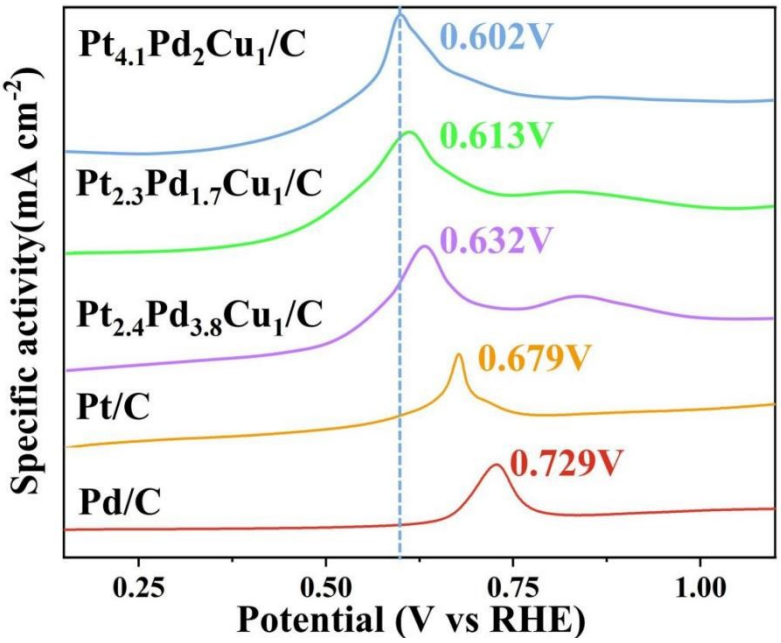

Fig. S11 CO stripping curves of Pt/C, Pd/C and $Pt_xPd_yCu_z$/C catalysts in 1 M KOH.

Table S1 Guanjun Chen *et al*.

Table S1 The onset and peak potentials of Pt/C, Pd/C and $Pt_xPd_yCu_z$/C catalysts in EOR.

	Onset Potential (V)	Peak Potential (V)
$Pt_{2.3}Pd_{1.7}Cu_1$/C	0.442	0.794
$Pt_{4.1}Pd_2Cu_1$/C	0.428	0.846
$Pt_{2.4}Pd_{3.8}Cu_1$/C	0.451	0.834
Pt/C	0.488	0.638
Pd/C	0.634	0.714