Supporting Information

Analysing Pd Metallosurfactant derived single atom catalyst for Biofouling Mitigation and oxygen reduction reaction in microbial fuel cell

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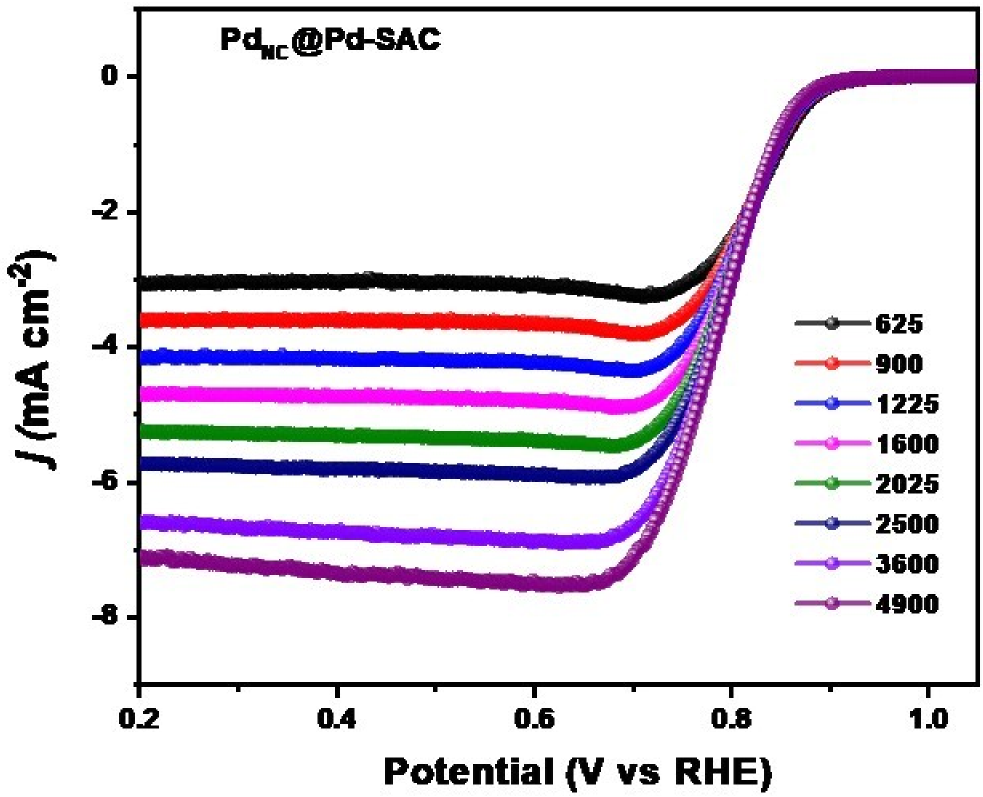

Figure S1. LSV plots of *Pd$_{NC}$@Pd-SAC* catalyst at different rotations (625-4900) in oxygen saturated alkaline solution.

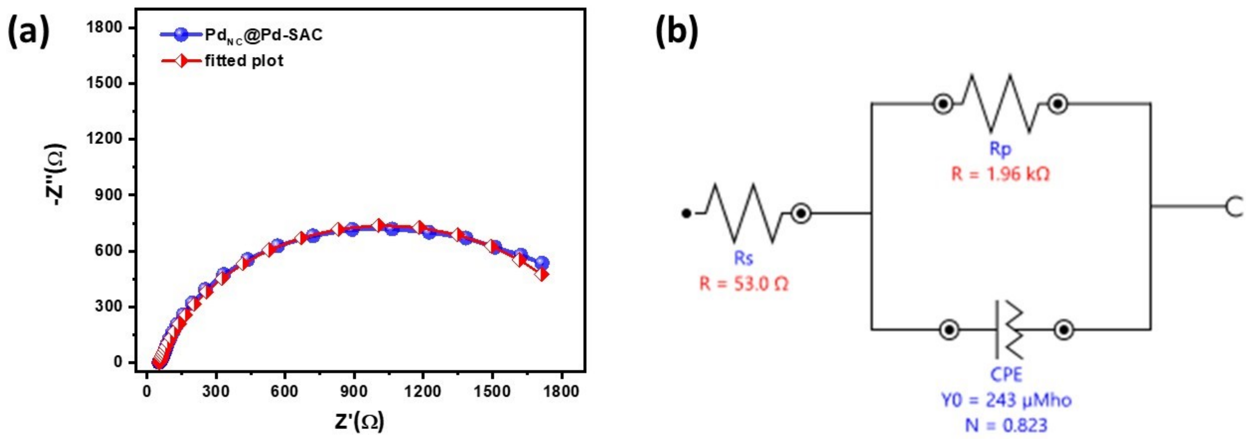

Figure S2. (a) Electrochemical impedance spectroscopy (EIS) spectra of Pd_{NC}@Pd-SAC material; (b) equivalent fitted circuit of Pd_{NC}@Pd-SAC material.

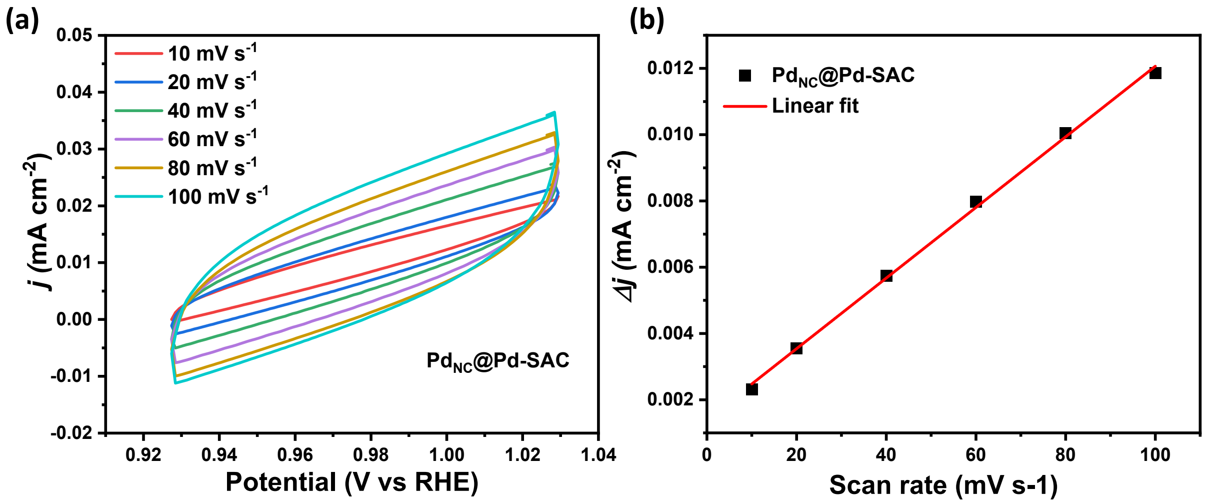

Figure S3. Electrochemical active surface area analysis (a) CV curves of Pd_{NC}@Pd-SAC catalyst at different scan rate (b) Linear fitting of capacitive currents of the Pd_{NC}@Pd-SAC catalyst vs scan rate

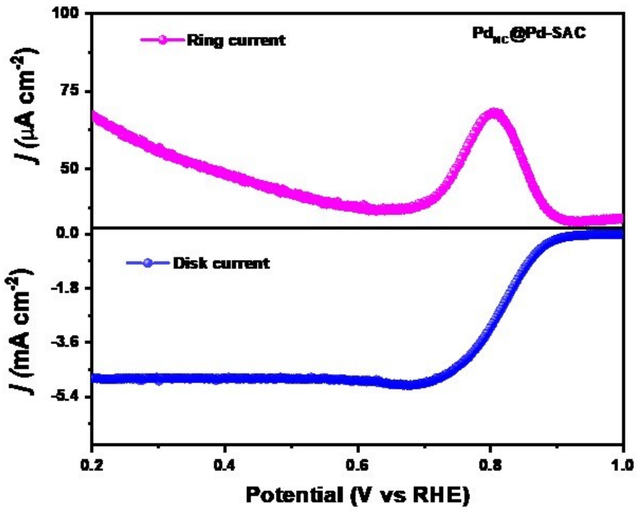

Figure S4. Linear sweep voltammetry (LSV) polarization curve of Pd_{NC}@Pd-SAC catalyst at 1600 rpm in O_2 saturated 0.1 M KOH electrolyte solution with ring and disk current density.

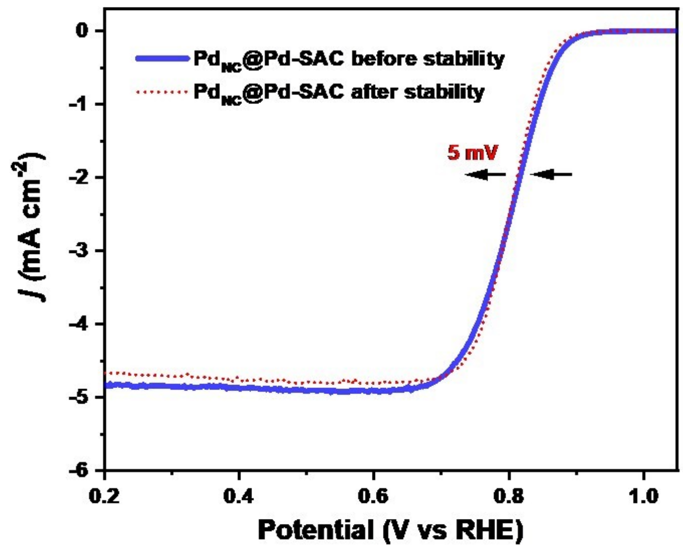

Figure S5. LSV curve of Pd$_{NC}$@Pd-SAC catalyst in 0.1 M KOH electrolyte before and after ORR analysis in alkaline media at 1600 rpm.

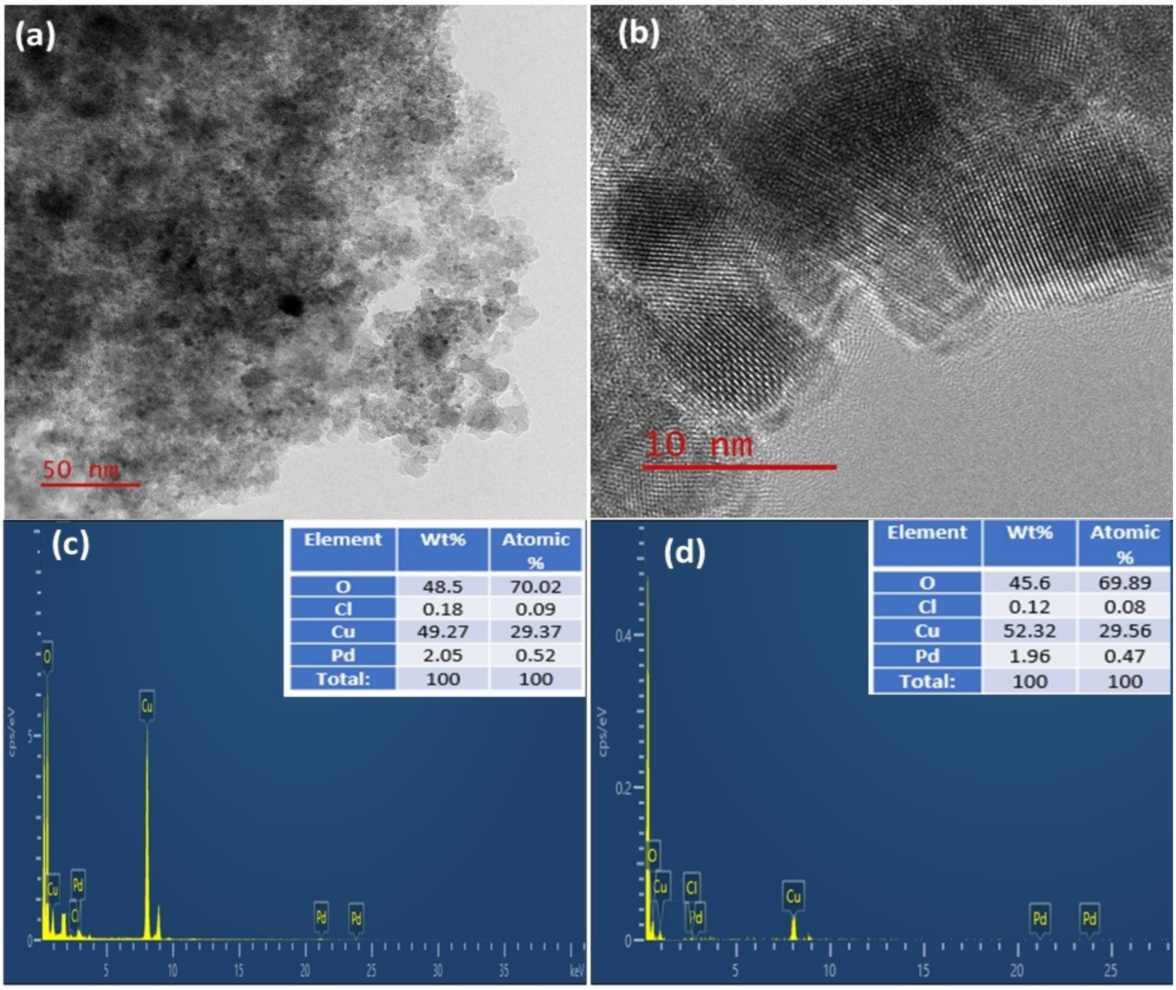

Figure S6. (a, b) HRTEM images after ORR analysis and (c) EDS spectra before and (d) after ORR analysis of Pd_{NC}@Pd-SAC catalyst in alkaline media at 1600 rpm.

Table S1: Comparison of different Pd based and Pd based bimetallic catalyst for ORR performance.

Catalyst Name	Half-Wave Potential ($E_{1/2}$ vs RHE)	Characteristic Features	Reference
Pd(II)-N macrocycle/CNT	0.86 V	N-coordinated Pd(II) SACs on CNTs; better O2 intermediate binding; high mass activity vs Pd bulk	[1]
PdNiMnO-PF	0.84 V	Porous architecture; enhanced Pd-support interaction; high Jd value; surface oxygenation tuning	[2]
7.5% Pd@$SmMn_2O_5$	0.83 V	Pd on mullite nanorods; atomic contact interface; moderate d-band; supports LAM mechanism	[3]
Pd/FeCoNC	0.88 V	Fe/Co/N co-doped carbon; graphene encapsulation; high durability; large diffusion current; Pd anchored on pyridinic N sites	[4]
Pd/TiO_2–C	0.88 V	TiO_2–C support with SMSI effect; photochemical synthesis; electron-rich Pd; high ORR activity	[5]
Pd/N–HsGY	0.849 V	Pure Pd(0) on N–graphyne; highest ORR activity; superior to Pd/C and Pt/C; high intrinsic and mass activity; durable Zn-air battery performance	[6]
Dealloyed PdNi/C	0.87 V	Electrochemical dealloying for surface tuning; Pd-rich surface.	[7]
Pd@PdFe core–shell icosahedra	0.90 V	Highest MA and SA; homogeneous dispersion; core–shell design.	[8]
PdCo@NPNC	0.914 V	N-doped porous carbon; 6.5× higher mass activity than Pt/C.	[9]
Pd_{NC}@Pd-SAC	0.82 V	Synergistic role of Pd SACs and Pd NPs to enhance ORR activity.	This work

References

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