

Supporting Information

Silver-Palladium Electrodeposition on Unsupported Vulcan XC-72R for Oxygen Reduction Reaction in Alkaline Media

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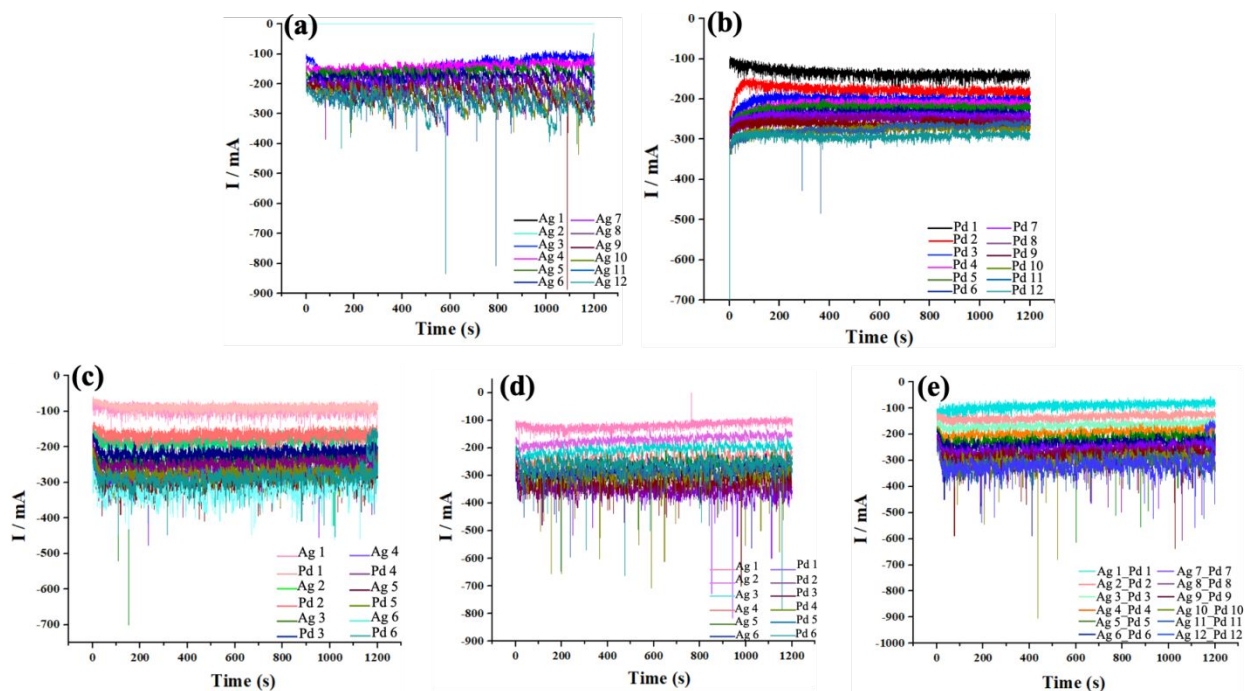


Figure S1. Chronoamperometry for Ag and Pd electrodeposition in 20 mL of a Vulcan XC-72R slurry in 0.1 M H_2SO_4 at 0.4V vs RHE for Ag (a), Pd (b), Ag/Pd in alternated (c), sequential (d), and simultaneous (e) methods respectively, supported in Vulcan XC-72R in which twelve electrodepositions are performed per 20 minute period. In each electrodeposition, a 2 mL and 0.4 mL aliquot of 5 mM of AgNO_3 and $\text{Pd}(\text{OAc})_2$, respectively, was added for the alternated and sequential method. For the simultaneous method, each electrodeposition consisted of a 1 mL and 0.2 mL aliquot of 5 mM of AgNO_3 and $\text{Pd}(\text{OAc})_2$.

Table S1. Chronoamperometry data results of Ag electrodeposition on Vulcan XC-72R using the RoDSE technique in different methods of electrodeposition.

| Electrodeposition Time (min) | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | Total |
|------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| % Ag/Vulcan Alternated | 0.00009 | 0.00009 | 0.00025 | 0.00025 | 0.00044 | 0.00044 | 0.00066 | 0.00066 | 0.00092 | 0.00092 | 0.00120 | 0.00120 | 0.12% |
| % Ag/Vulcan Sequential | 0.00010 | 0.00027 | 0.00047 | 0.00070 | 0.00093 | 0.00120 | 0.00120 | 0.00120 | 0.00120 | 0.00120 | 0.00120 | 0.00120 | 0.12% |
| % Ag/Vulcan Simultaneous | 0.00000 | 0.00000 | 0.00000 | 0.00011 | 0.00022 | 0.00036 | 0.00050 | 0.00067 | 0.00084 | 0.00101 | 0.00120 | 0.00140 | 0.14% |

Table S2. Chronoamperometry data results of Pd electrodeposition on Vulcan XC-72R using the RoDSE technique in different methods of electrodeposition.

| Electrodeposition Time (min) | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 | 220 | 240 | Total |
|------------------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| % Pd/Vulcan Alternated | 0.00071 | 0.00071 | 0.00214 | 0.00214 | 0.00427 | 0.00427 | 0.00641 | 0.00641 | 0.00925 | 0.00925 | 0.01210 | 0.01210 | 1.21% |
| % Pd/Vulcan Sequential | 0.00454 | 0.00908 | 0.01271 | 0.01634 | 0.01998 | 0.02270 | 0.02270 | 0.02270 | 0.02270 | 0.02270 | 0.02270 | 0.02270 | 2.27% |
| % Pd/Vulcan Simultaneous | 0.00135 | 0.00269 | 0.00471 | 0.00673 | 0.00875 | 0.01077 | 0.01279 | 0.01481 | 0.01683 | 0.01952 | 0.02221 | 0.02490 | 2.49% |

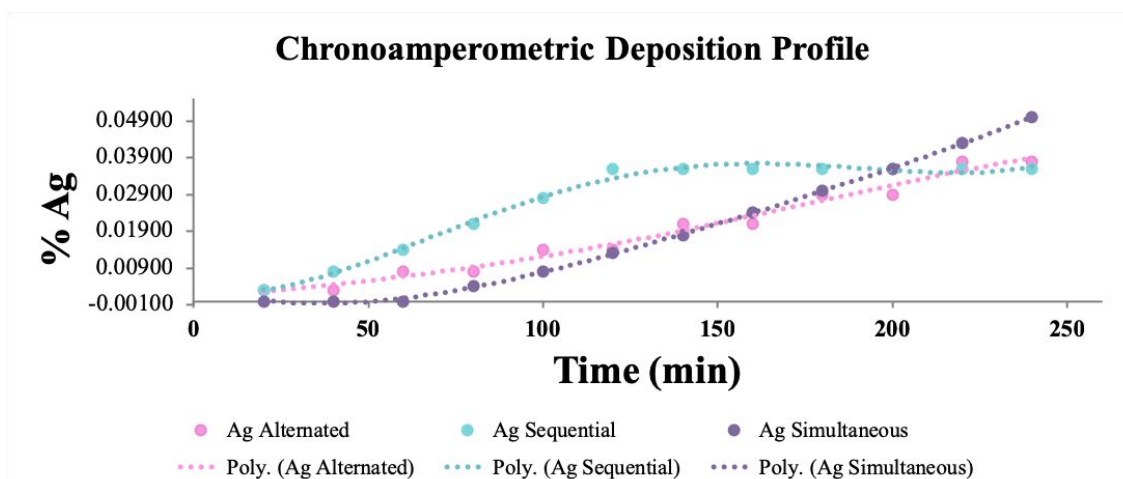


Figure S2. Chronoamperometry deposition profile for Ag electrodeposition in 20 mL of Vulcan XC-72R slurry in 0.1 M H₂SO₄ at 0.4V vs RHE in alternated, sequential, and simultaneous methods, respectively, supported in Vulcan XC-72R in which twelve electrodepositions were performed for a total time of 240 minutes.

Chronoamperometric Deposition Profile

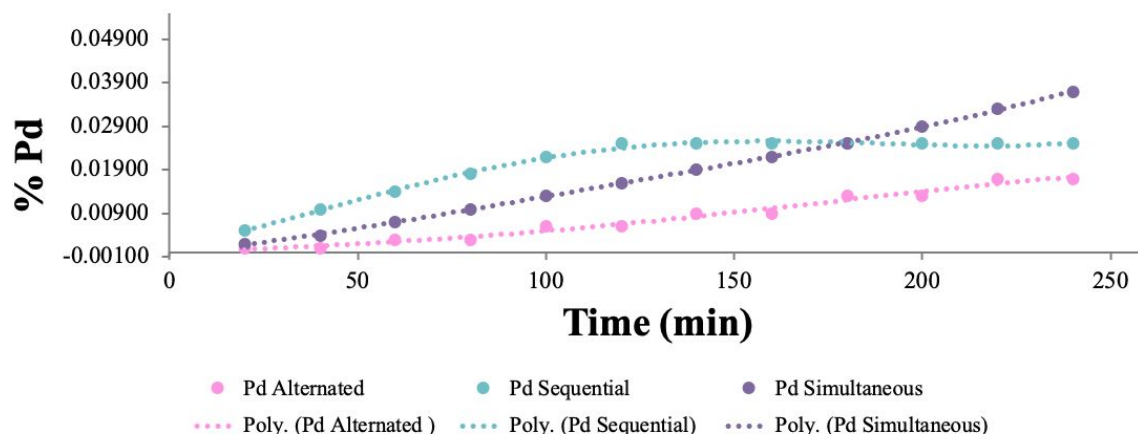


Figure S3. Chronoamperometry deposition profile for Pd electrodeposition in 20 mL of Vulcan XC-72R slurry in 0.1 M H₂SO₄ at 0.4V vs RHE in alternated, sequential, and simultaneous methods respectively, supported in Vulcan XC-72R in which twelve electrodepositions were performed for a total time of 240 minutes.

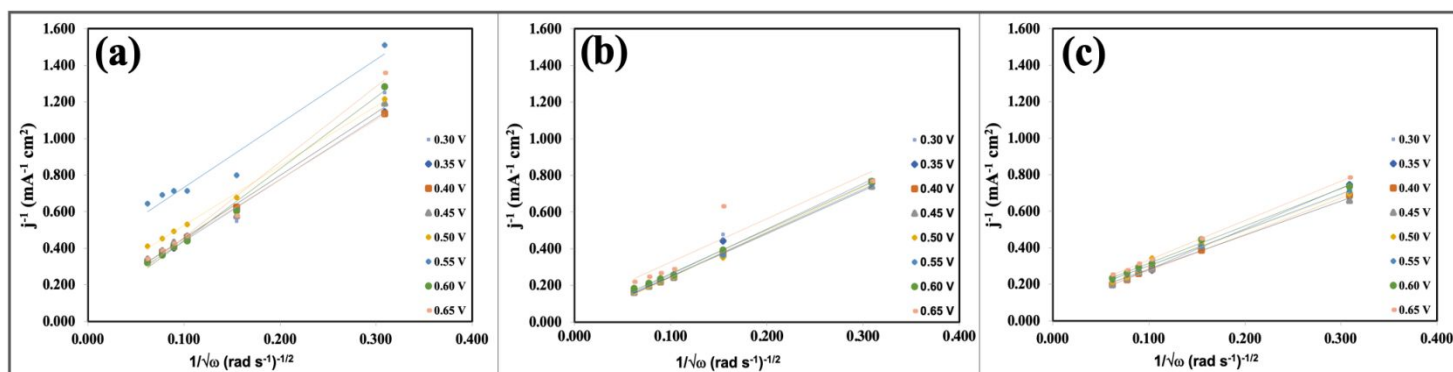


Figure S4. Koutecky-Levich plot for the O₂ reduction for: (a) Ag/Vulcan, (b) Pd/Vulcan, and 20 wt.% Pt on Vulcan in O₂ saturated 0.1 M KOH for electrode potentials 0.30, 0.35, 0.40, 0.45, 0.50, 0.55, 0.60 and 0.65V vs. RHE. Solid lines show the linear regressions for all potentials.

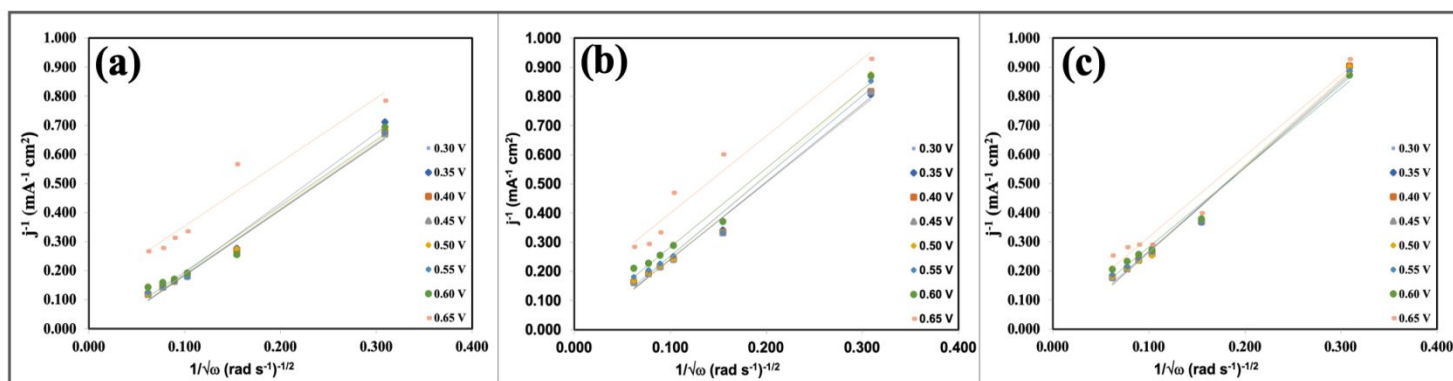


Figure S5. Koutecky-Levich plot for the O₂ reduction for electrochemically reduced Ag/Pd/Vulcan in (a) alternated, (b) sequential, and (c) simultaneous methods in O₂ saturated 0.1 M KOH for electrode potentials 0.30, 0.35, 0.40, 0.45, 0.50, 0.55, 0.60 and 0.65V vs. RHE. Solid lines show the linear regressions for all potentials.

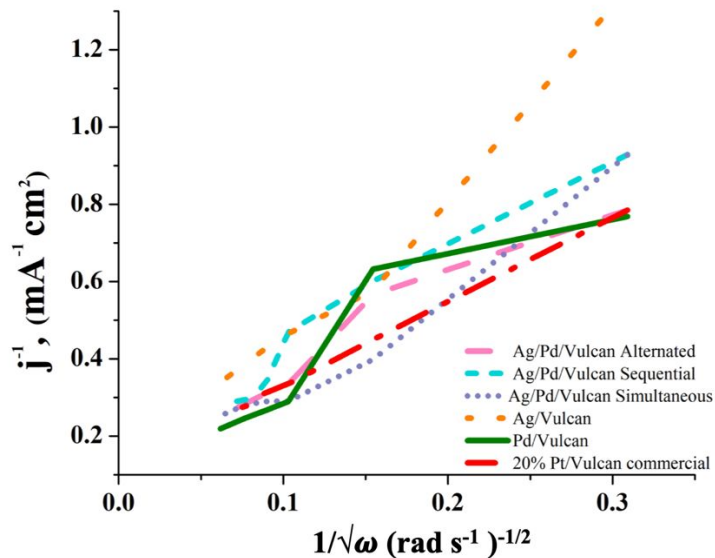


Figure S6. Koutecky-Levich plots of different catalysts at 0.65 V vs. RHE at 1600 rpm in 0.1M KOH.

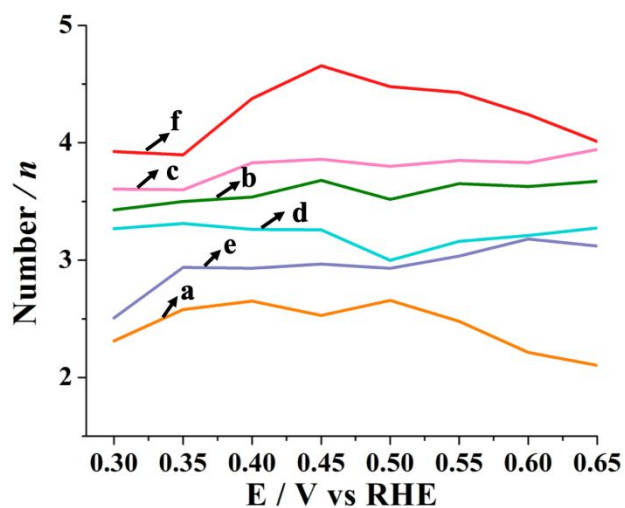


Figure S7. Number of transferred electrons curve for ORR on (a) Ag/Vulcan, (b) Pd/Vulcan (c) Ag/Pd/Vulcan alternated, (d) Ag/Pd/Vulcan sequential, (e) Ag/Pd/Vulcan simultaneous, and (f) 20%Pt/Carbon Vulcan at 1600 rpm in 0.1M KOH.