Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.
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Electronic Supporting Information

A one-step synthesis of Co-P-B / rGO at room-temperature with synergistically enhanced electrocatalytic activity in neutral solution

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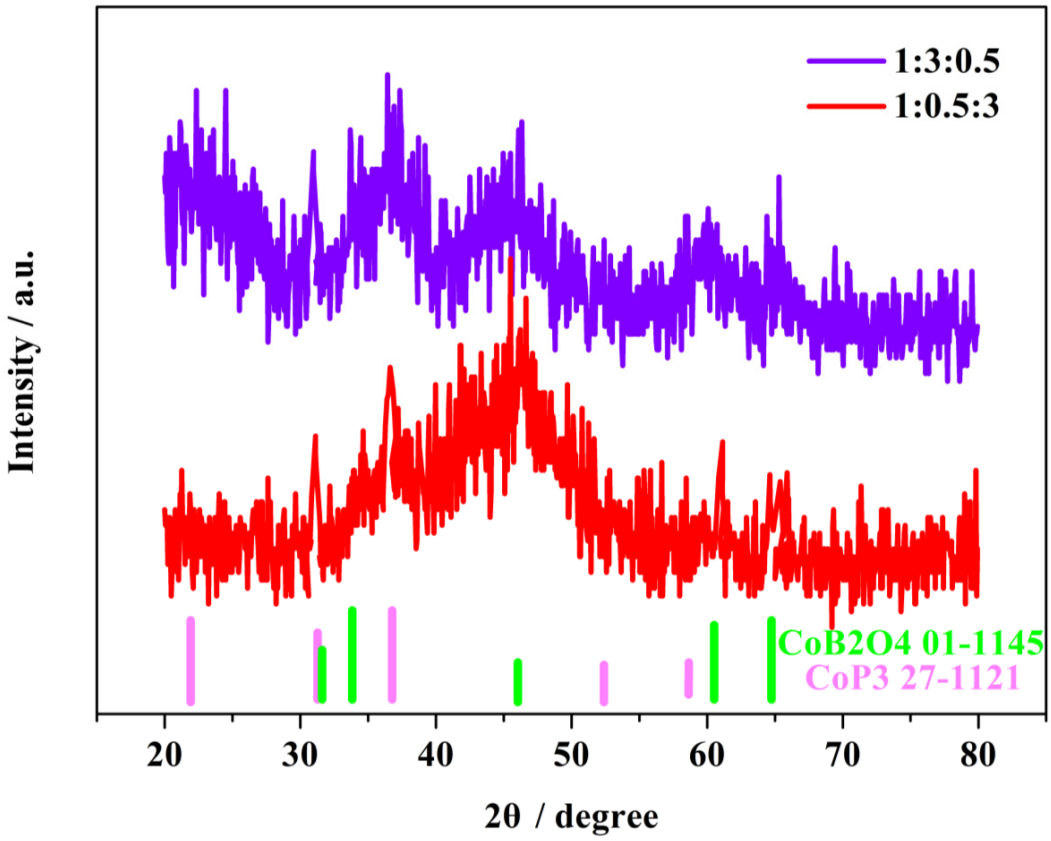


Fig. S1 XRD patterns of B3-G (red) and P3-G (blue).

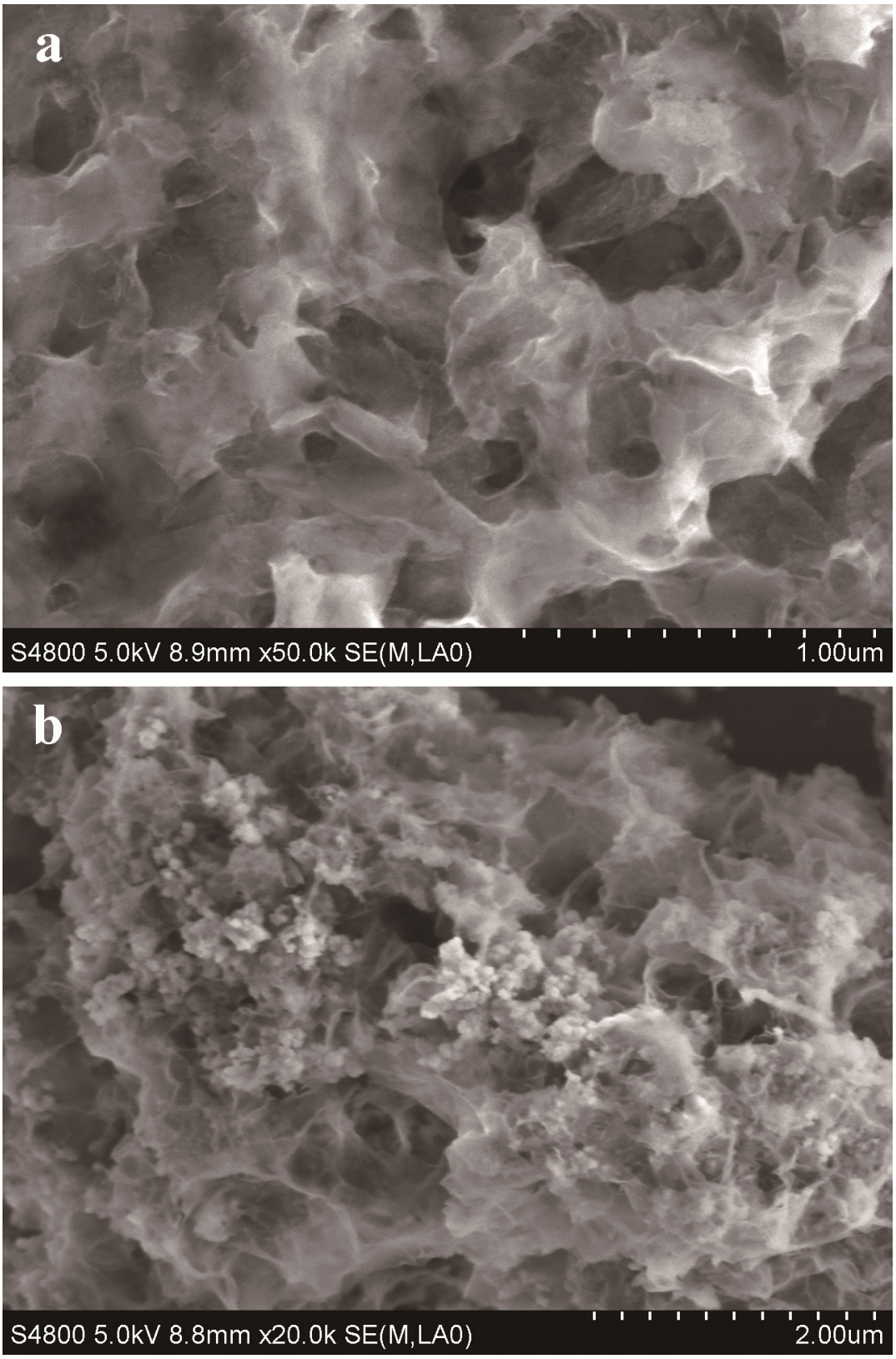


Fig. S2 The SEM images of B3 **(a)** and B3-G **(b)**.

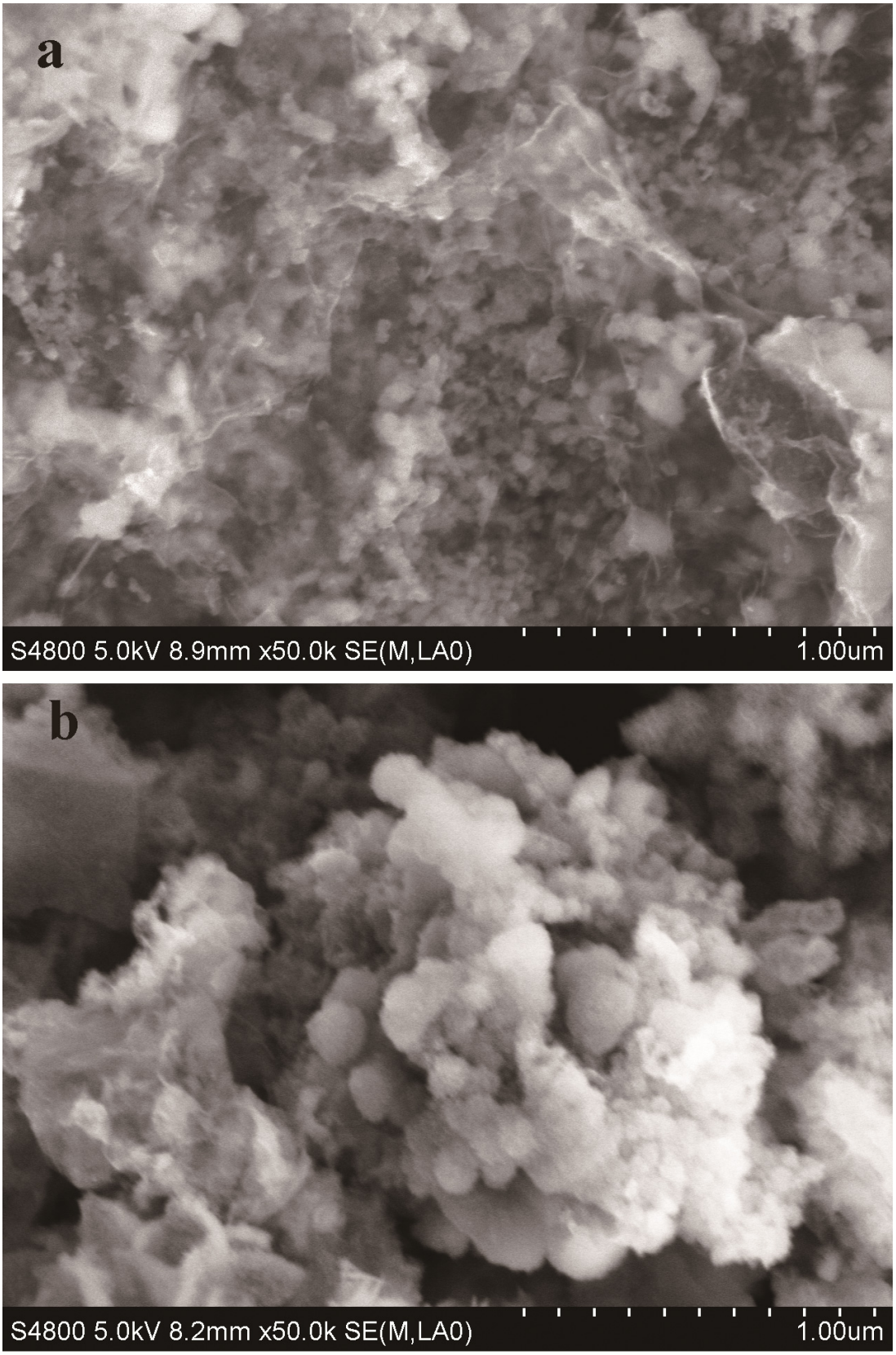
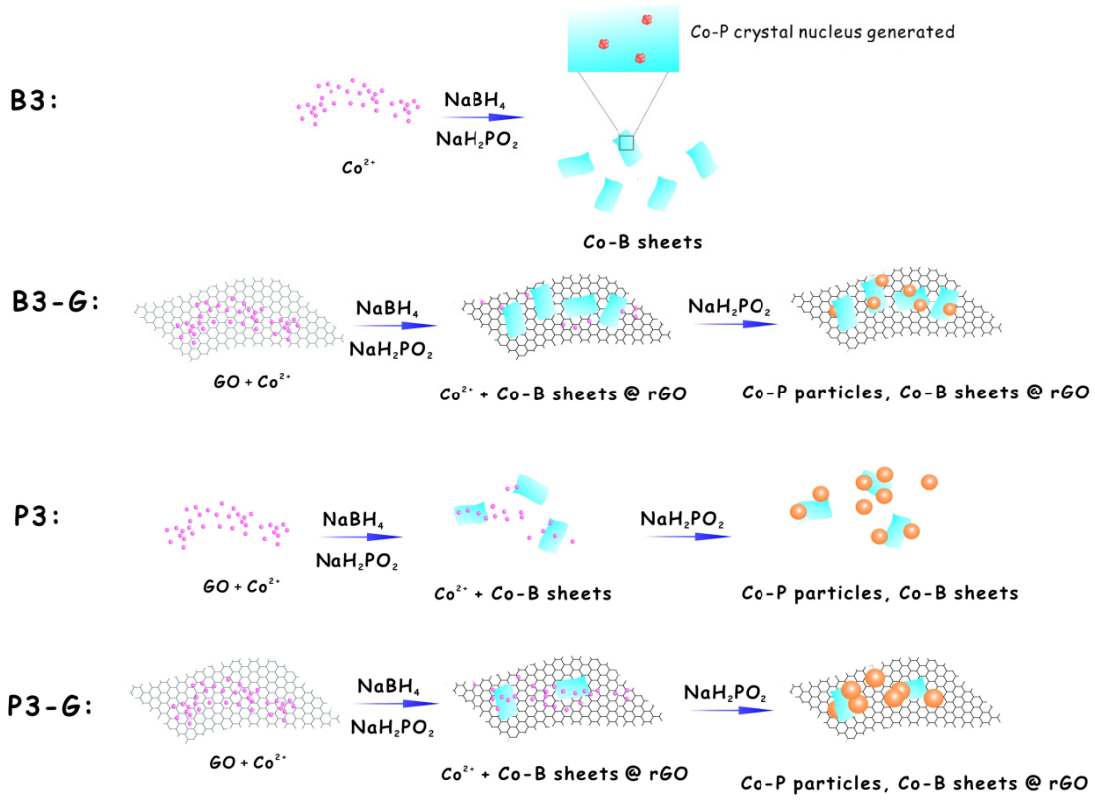


Fig. S3 The SEM images of P3 **(a)** and P3-G **(b)**.



Scheme S1. The schematic processes for the formation of B3, B3-G, P3 and P3-G.

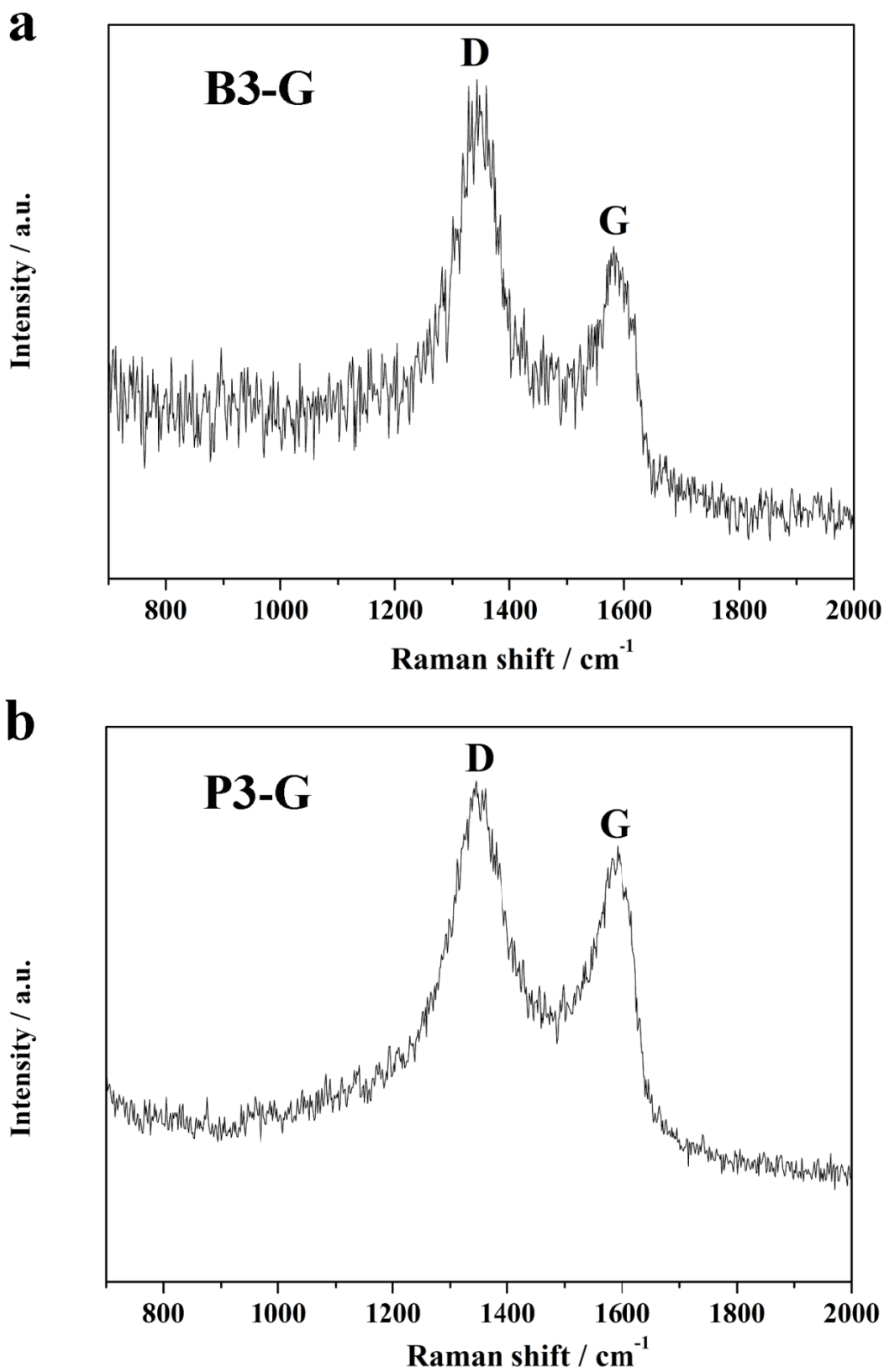


Fig. S4 Raman spectra of B3-G **(a)** and P3-G **(b)**.

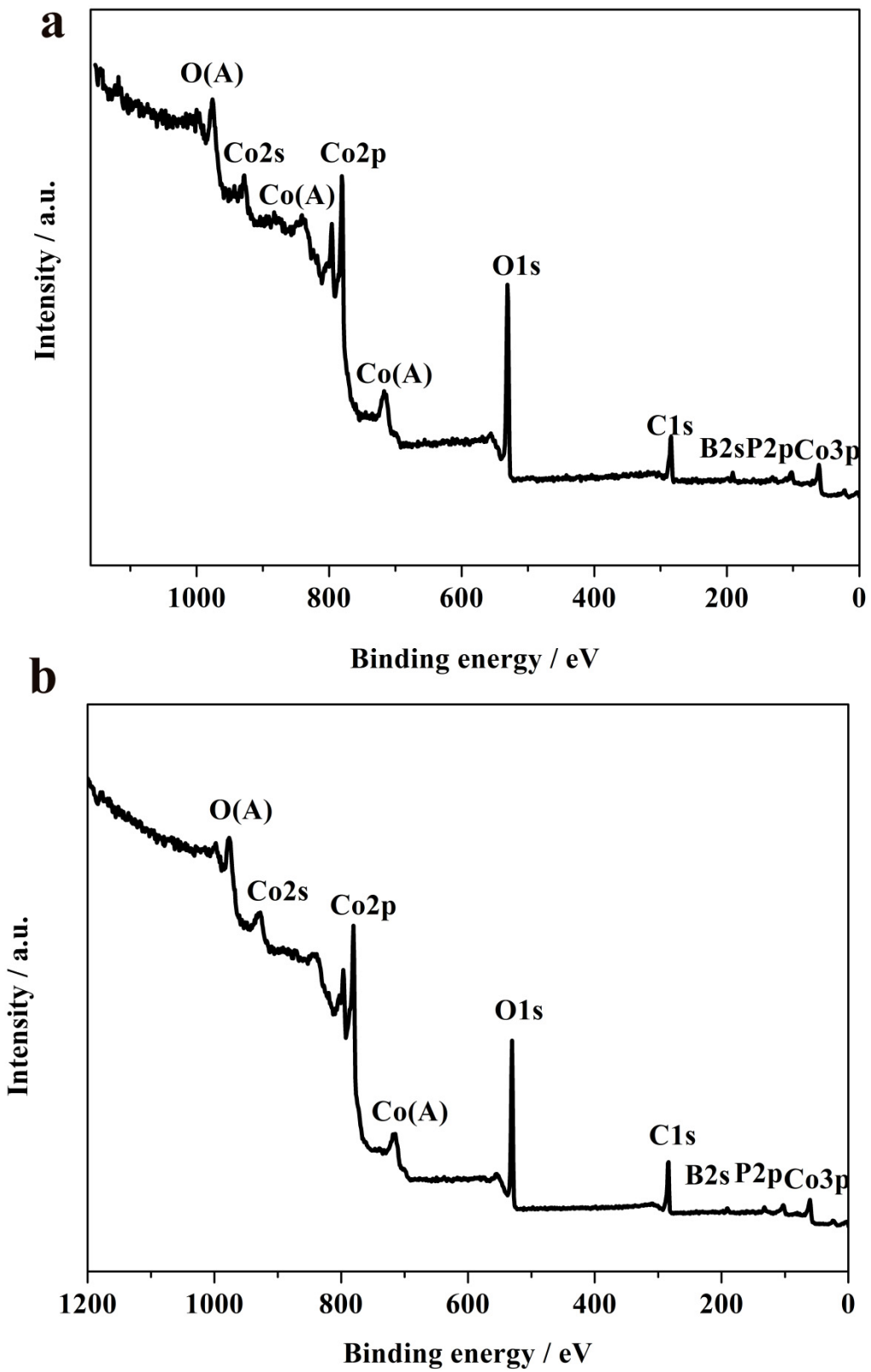


Fig. S5 XPS survey spectra of B3-G **(a)** and P3-G **(b)**.

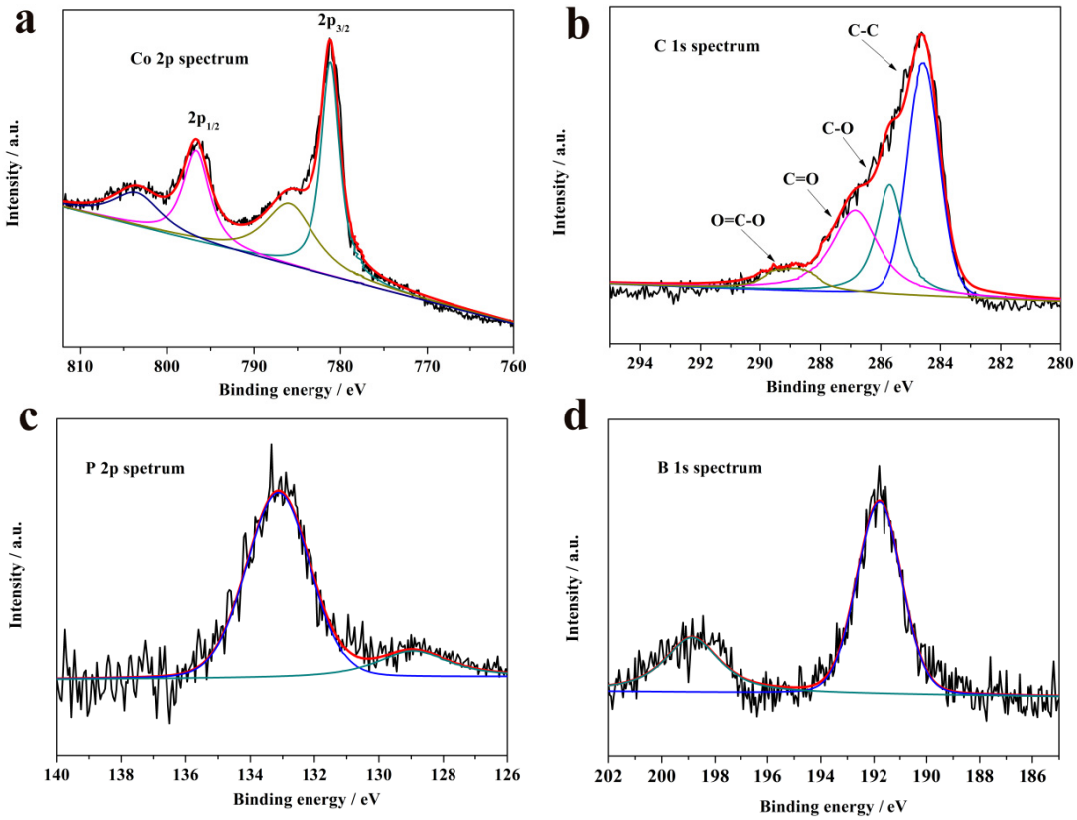


Fig. S6 High revolution XPS spectra of P3-G.

Table S1. The contents of Co, C, B and P for B3-G and P3-G.

	B3-G		**P3-G**	
	Atomic Concentration (%)	**Mass Concentration (%)**	**Atomic Concentration (%)**	**Mass Concentration (%)**
Co	22.02	57.31	23.40	58.87
C	59.73	31.68	61.42	31.49
B	15.68	7.49	12.13	5.6
P	2.57	3.52	3.05	4.04

The onset-potential for OER was obtained from Tafel plot.[1] In Fig. S7, a small semicircle appears at the semi-log plot of B3-G in the region of low current densities (from 1.20 V to 1.276 V). While the curve comes to the inflection point at 1.276 V, the value of lg(j / mA cm^{-2}) starts to deviate above 1.281 V. Therefore, 1.281 V is established as the onset potential for B3-G. The same method was applied to determine the onset overpotential for other samples in this work.

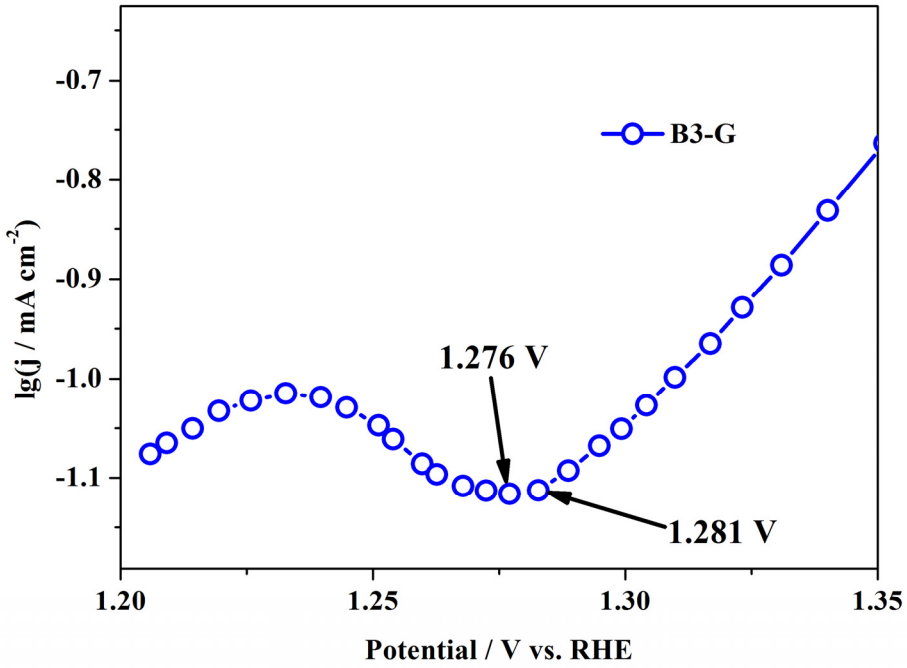


Fig. S7 The Tafel plot of B3-G at the low current density range.

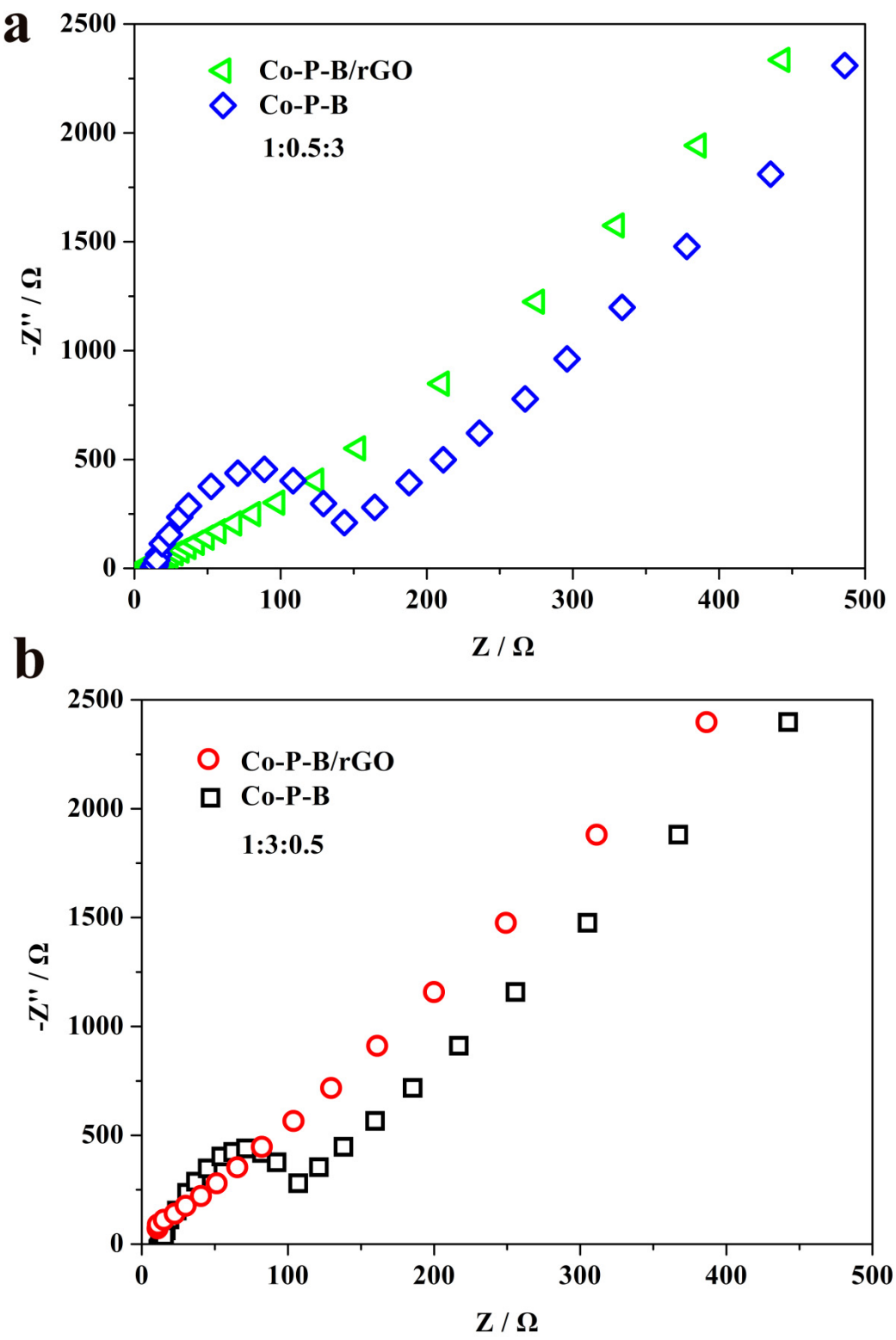


Fig. S8 EIS spectra of Co-P-B with rGO and without rGO.

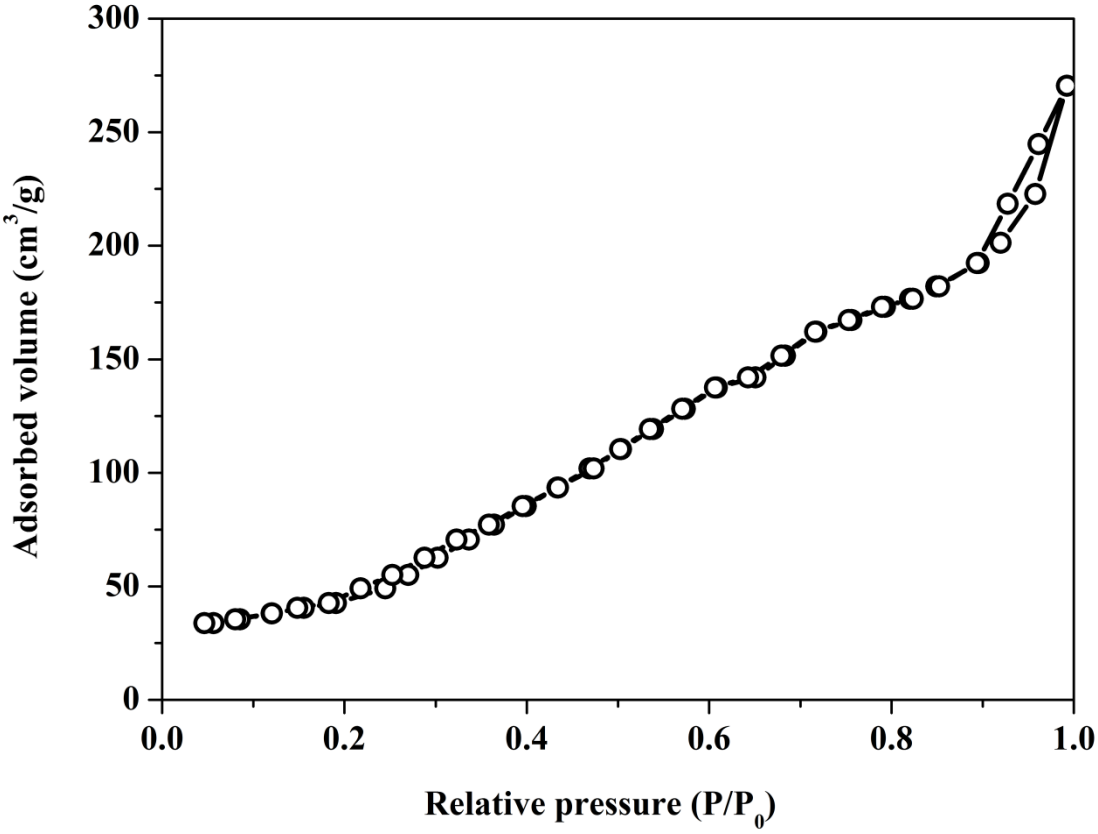


Fig. S9 Nitrogen adsorption-desorption isotherm of B3-G (BET surface area = 192 m^2/g).

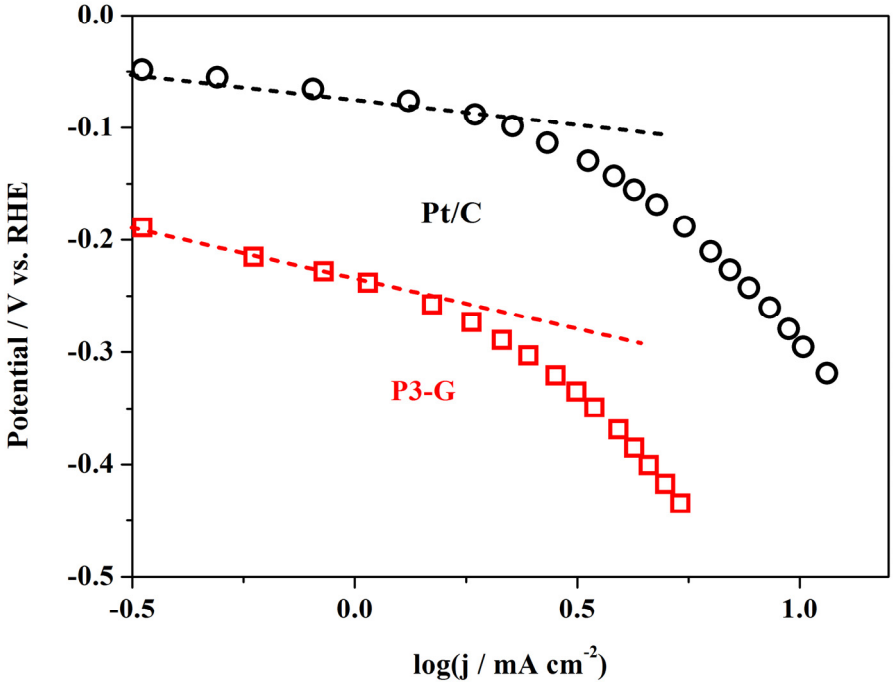


Fig. S10 Tafel plots of P3-G and Pt/C (20% wt) for HER.

Table S2. Corresponding parameters selected from the polarization curves of Fig. 6 for HER.

Catalysts (Co/P/B)	Onset potential (V)	η (V) @ 5 mA cm^{-2}	η (V) @ 10 mA cm^{-2}	Tafel slope (mV dec^{-1})
1:0:3.5	-0.327	-0.588	—	118
1:0.5:3	-0.322	-0.626	—	128
1:1:2.5	-0.247	-0.566	—	118
1:1.75:1.75	-0.219	-0.542	—	116
1:2.5:1	-0.215	-0.478	—	101
1:3:0.5	-0.168	-0.418	-0.639	82
1:3.5:0	-0.327	-0.713	—	130
Pt/C	-0.062	-0.219	-0.318	60

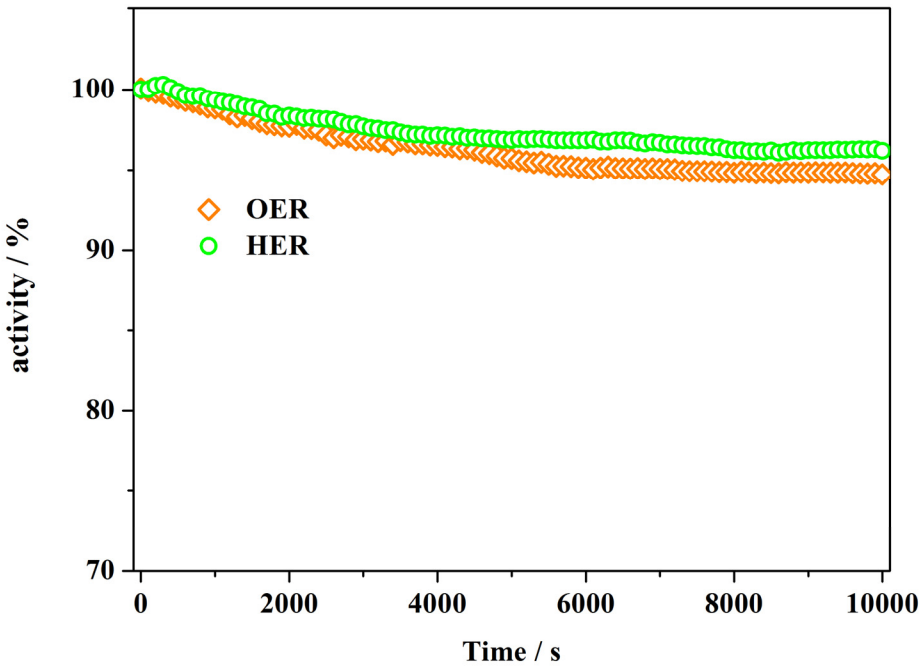


Fig. S11 The stability of B3-G for OER and P3-G for HER in artificial seawater at the overpotential of 200 mV.

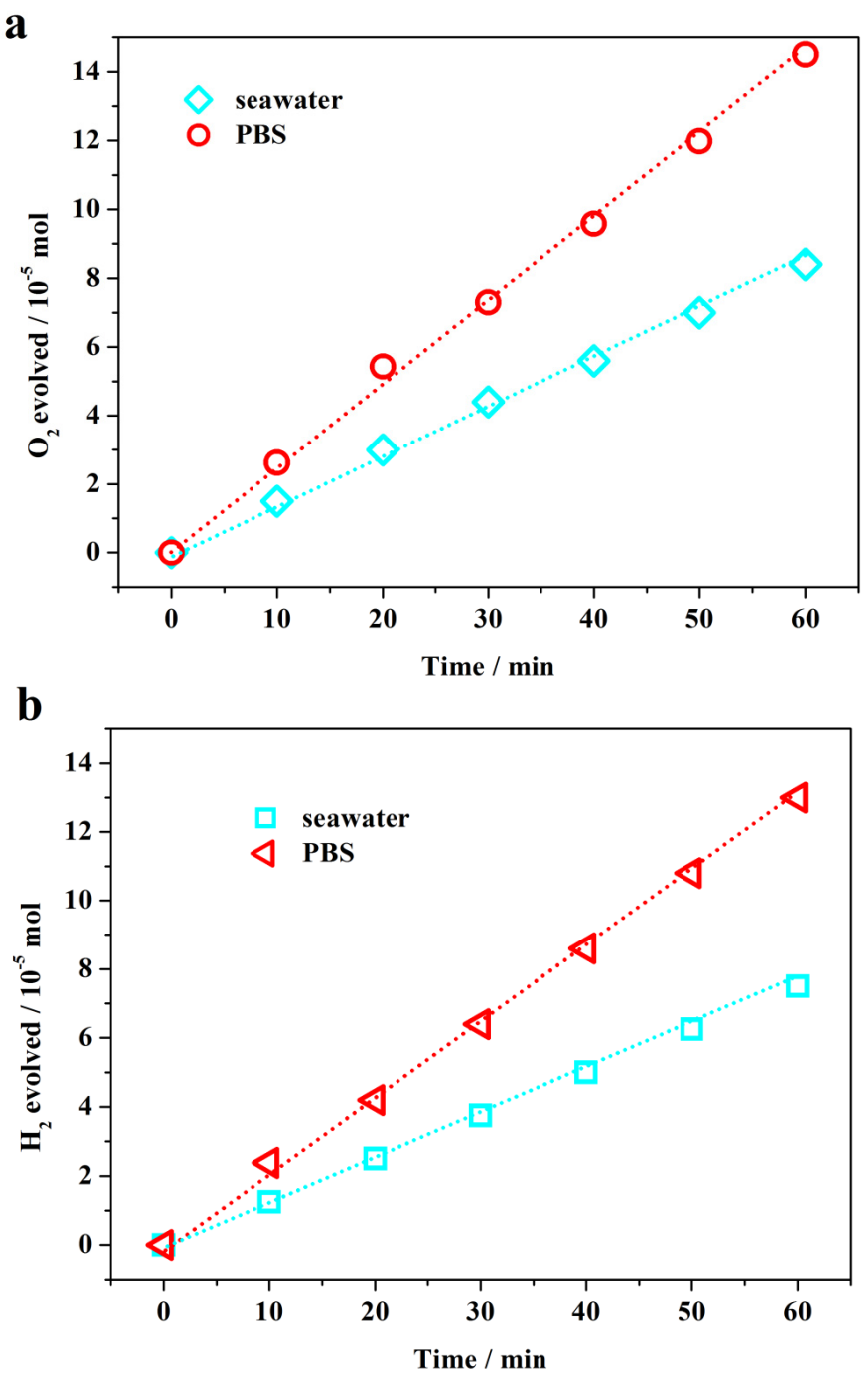


Fig. S12 The Faradic efficiency testing of B3-G for OER and P3-G for HER in both PBS and seawater. The spots are the experimentally measured the amount of evolved **(a)** oxygen and **(b)** hydrogen during 60 min at an applied overpotential of 0.5 V; the dot lines are the theoretical values.

References:

1. W. F. Chen, K. Sasaki, C. Ma, A. I. Frenkel, N. Marinkovic, J. T. Muckerman, Y. M. Zhu and R. R. Adzic, *Angew. Chem. Int. Ed.*, 2012, **51**, 6131-6135.