Supporting information

An Air Chargeable Hydrogen Battery by Reversible Electrochemical Trapping of the Protons

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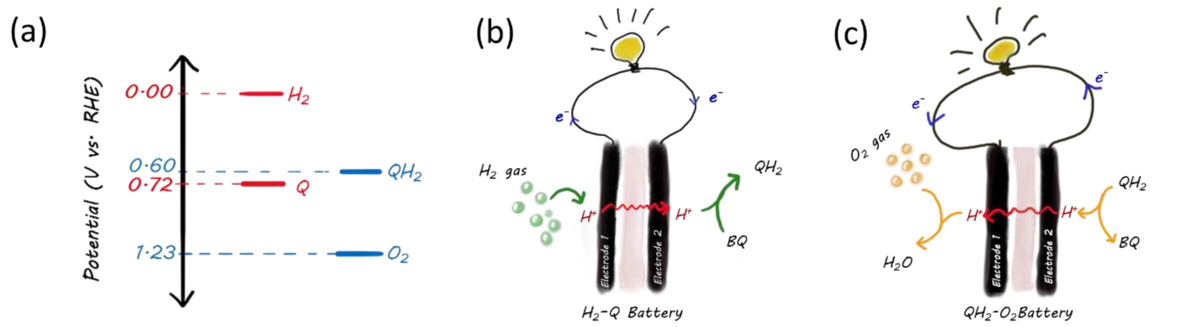
Results and discussion:



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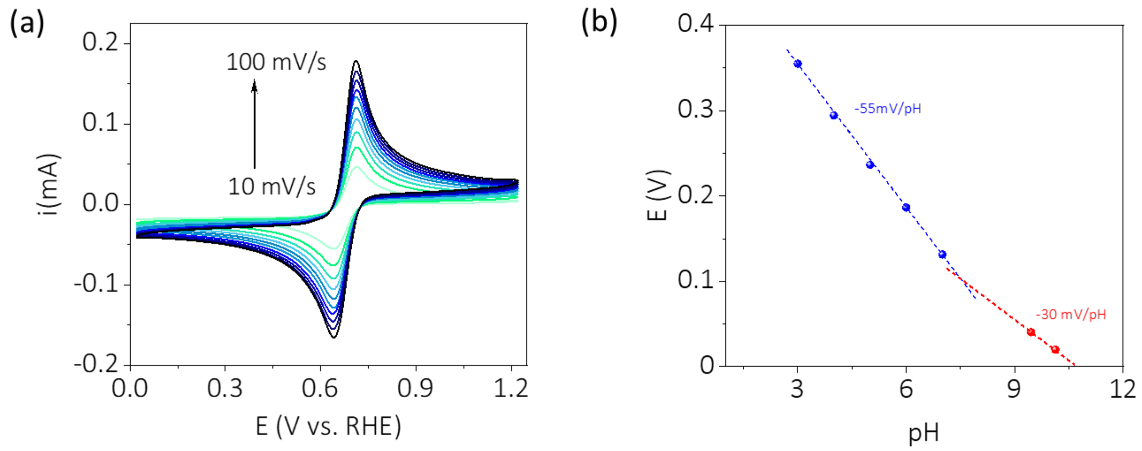

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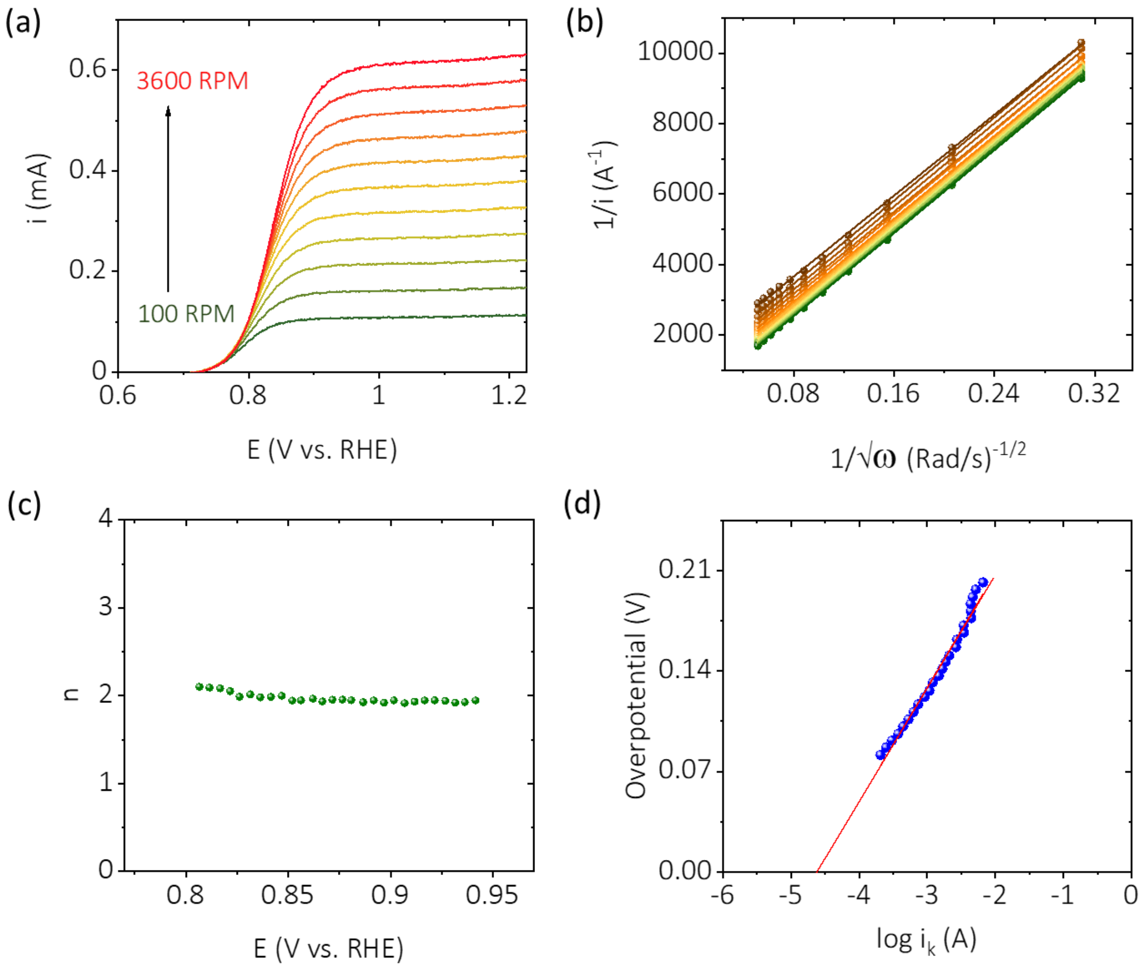

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Table S1: Electrochemical parameters extracted from RRDE and Kouteckey-Levich plot.

Species	No: of electrons	β	Rate constant (cm/s)
Benzoquinone/Hydroquinone	2.03	0.42	1.3 $*10^{-4}$

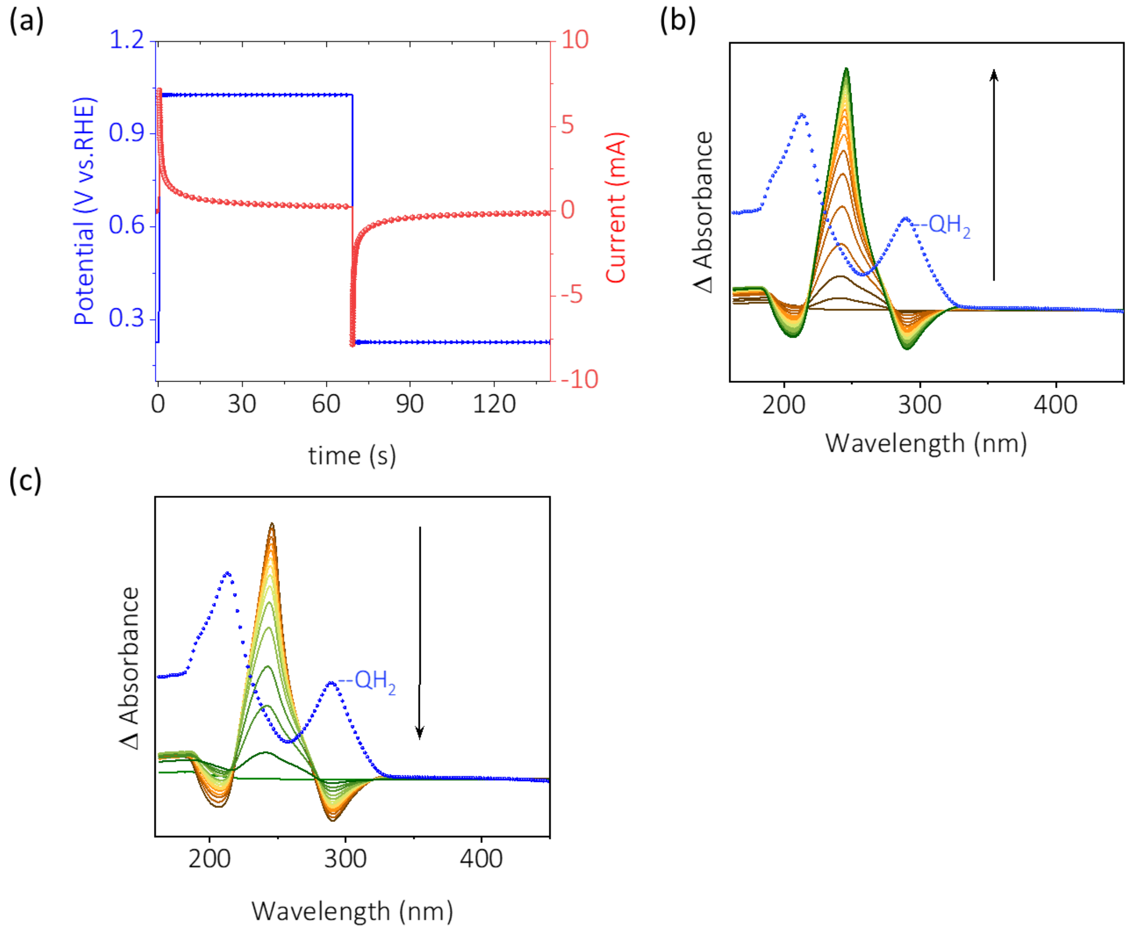

Figure S4: In-situ UV-Vis spectroelectrochemistry data for the redox reaction of benzoquinone. (a) Chronoamperometry, (b) the potential dependent spectra acquired during the oxidation scan and (c) during the reduction scan.

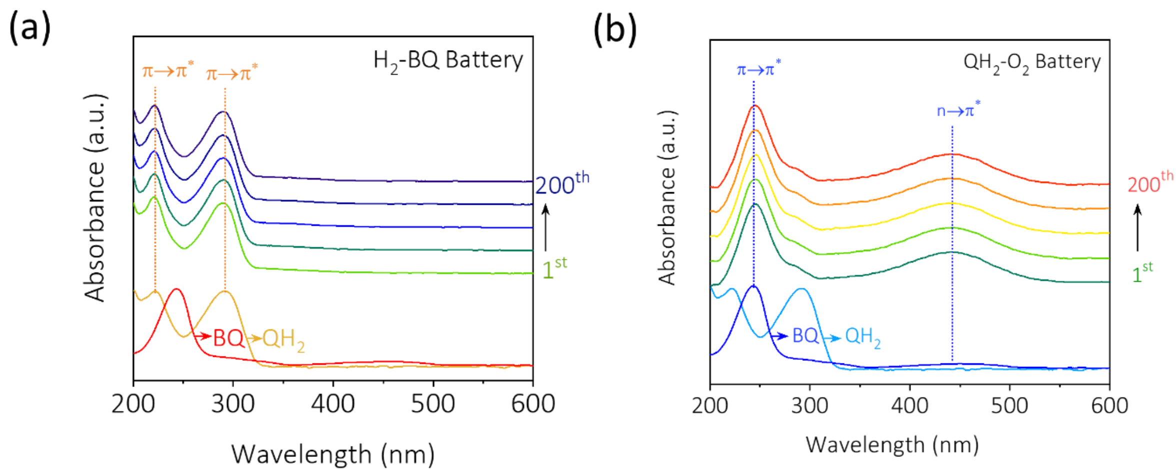

Figure S5: UV-Vis spectra (a) H_2-Q battery cathode and (b) QH_2–O_2 battery anode during different discharge cycles.

Table S2: Battery discharge capacity

	Discharge capacity in mAh/g	
	H_2-BQ Battery	QH_2–O_2 Battery
1st cycle	364.69	364.54
10th cycle	364.14	362.97
50th cycle	355.13	353.70
100th cycle	343.24	342.00
200th cycle	330.44	329.41

Table S3: Calculation of cumulative capacity

	Cumulative discharge capacity (mAh/g)	
	H_2-BQ Battery	QH_2-O_2 Battery
1st – 10th cycle	3644.15	3637.55
11th – 50th cycle	14385.44	14333.40
51th -100th cycle	17459.17	17392.55
101th – 200th cycle	33684.15	33570.00
Total	69172.91	68933.50

Calculation S1:

Amount(g) of BQ used in 100 ml of 0.1 M solution : $\frac{108.1*0.1*100}{1000} = 1.081\ g$

No: of moles of BQ : $\frac{1.081}{108.1} = 0.01\ moles$

Electric charge : 0.01* 2 = 0.02 F

Amount of hydrogen required : 0.01 moles

Amount of oxygen required : 0.005 moles

Calculation S2:

First discharge capacity of H_2-BQ battery: 364.69 mAh/g

Cumulative capacity of H_2-BQ battery after 200 cycles: 69172.91 mAh/g

Cumulative capacity of QH_2-O_2 battery after 200 cycles: 68933.5 mAh/g

Cumulative capacity of the battery in total: 138106.41 mAh/g

Amount (g) of BQ required to achieve a capacity of 69172.91 mAh (Table S3) in primary battery configuration: 69172.91 / 364.69 = 189.67 g

Similarly, amount (g) of QH_2 required to achieve a capacity of 68933.5 mAh (Table S3) in primary battery configuration: 68933.50 / 364.54 = 189.09 g

Therefore, cumulative capacity during discharge and air charge processes = 378.76 g