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

Supporting Information

Pathways Towards High Performance Na-O_2 Batteries: Tailoring Graphene Aerogel Cathode Porosity & Nanostructure

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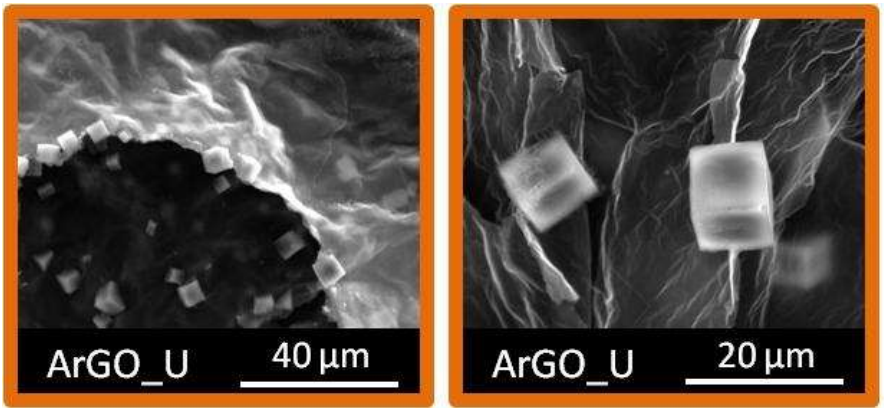

Fig. S1. SEM images of galvanostatically discharged ArGO_U cathode at 100 mAh g^{-1} to 1.8 V showing the O_2/electrode interface.

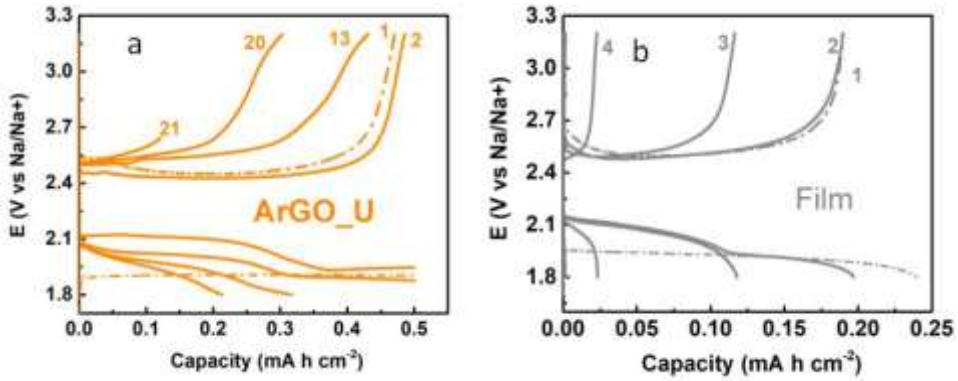

Fig. S2. a) Cyclability test for ArGO_U and (b) Film electrodes at 100 mA/g and 0.5 mAh cm^{-2} using 0.1M $NaClO_2$ in DME as electrolyte.

Table S1. Electrochemical Properties of Na-air/O_2 batteries produced by this work and from literatures.

		Discharge properties			Cycling performance			
Air-cathode [loading (mg) and area (cm^2)]	**Electrolyte/ Environment**	**Capacity**	**Discharge product**	**Morphology**	**Voltage range (V)**	**Cycles**	**Overpotential (V)**	**Ref. in the manuscript**
Graphene nanosheets [unknown]	0.25 $NaPF_6$ DME [1]	9268 mAh g^{-1} at 200 mA g^{-1}	Na_2O_2	Film	1.5-4	10 (300 mA g^{-1} to 1200 mAh g^{-1})	1.46 - 1.59	39
Nitrogen doped graphene [0.3;0.71]	0.5 mol dm^{-3} $NaSO_3CF_3$ DEGDME [2]	6000 mAh g^{-1} or 3.63 mAh cm^{-2} at 75 mA g^{-1}	Na_2O_2	small particles	1.8-3.6	3 (75 mA g^{-1} to 1150 mAh g^{-1})	0.6	40
Graphene nanosheets with Pt nanoparticles [unknown]	1M $NaClO_4$:PC[3]	7574 mAh g^{-1} at 0.1mA cm^{-2}	Na_2CO_3	Nanometric particles	2-3.5	10 (0.1 mA cm^{-2} to 100 mAh g^{-1})	1.3	41
Ag-reduced graphene oxide [0.85 mg cm^{-2}]	1M $NaPF_6$ TEGDME[3]	566 mAh g^{-1}at 0.1mA cm^{-2}	NaO_2, Na_2O_2 and Na_2O	Nanometric particles	1.5-4.5	30 (0.2 mA cm^{-2} to 0.125 mAh cm^{-2})	0.9	42
Reduced graphene oxide [0.15;0.5]	0.25M $NaClO_4$ DME[3]	40000 mAh g^{-1} or 12 mAh cm^{-2} at 0.1 mA cm^{-2}	NaO_2	Cubic particles	1.8-2.8	17 (0.1 mA cm^{-2} to 1 mAh cm^{-2})	0.4	36
Micrometer-sized RuO_2 catalyst-coated B-rGO [0.5 mg cm^{-2}]	1M $NaCF_3SO_3$ TEGDME[3]	0.5 mAh cm^{-2} at 0.05mA cm^{-2}	NaO_2	Cubic particles	1.8-4.5	100 (0.05 mA cm^{-2} to 0.5 mAh cm^{-2})	1	43
This work [1.5-2.5,0.95]	0.1M $NaClO_4$ DME[3]	3594 mAh g^{-1} or 6.61 mAh cm^{-2} at 100 mA g^{-1}	NaO_2	Cubic particles	1.8-3.2	40 (100 mA g^{-1} / 0.15-0.25 mA cm^{-2} to 0.5 mAh cm^{-2}) 100 (100 mA g^{-1}/0.15 mA cm^{-2} to 0.15 mAh cm^{-2})	0.26	–

[1] dried air

[2] 1atm O_2

[3] O_2

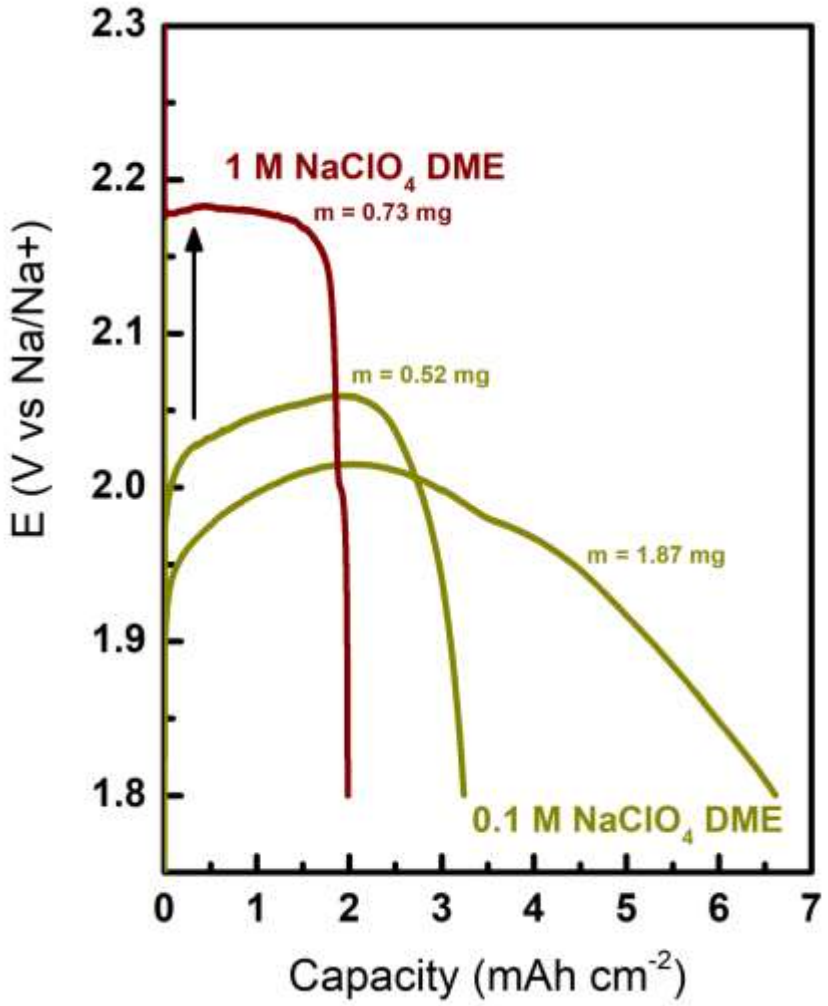

Fig S3. (a) Voltage versus capacity of ArGO_N graphene-based electrodes discharged galvanostatically at 100 mA g^{-1} to full capacity in two electrolyte concentrations: 0.1 and 1 M $NaClO_4$ in DME. The difference in overpotential between 0.1 M and 1 M electrolyte solutions is indicated by an arrow.

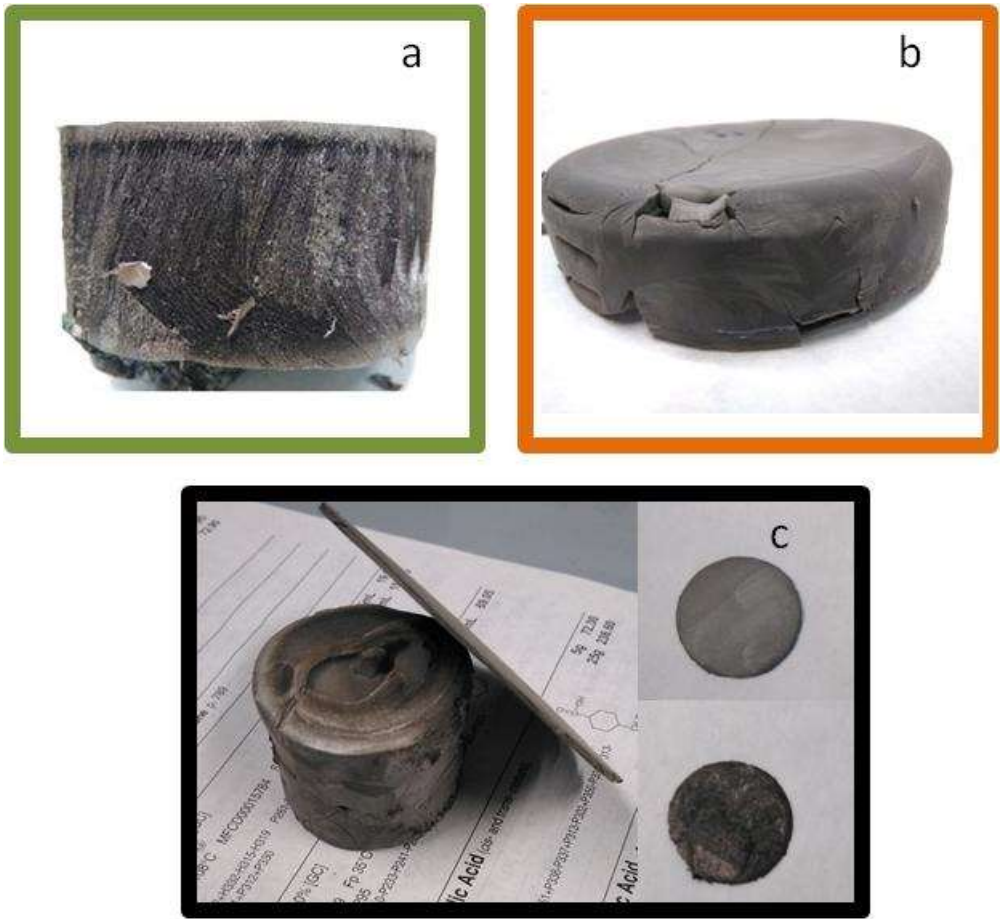

Fig. S4. Images of the two prepared cryogels; (a) ArGO_U and (b) ArGO_N and (c) some self-standing binder-free electrodes processed from the aerogels.