Electronic Supplementary Material (ESI) for RSC Advances.


**Supporting information**

# Uniform Gallium Oxyhydroxide Nanorods Anodes with Superior Lithium-Ion Storage

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The theoretical capacity of 1304 mAh/g for GaOOH is calculated via the following process:

$$C_0 = 1000\, nF/3600M \qquad (1)$$

$C_0$ is the theoretical specific capacity; $F$ is Faraday constant (1F=96500 C/mol); $M$ is molecular weight of matter and $M_{(GaOOH)}$=102.72; $n$ is number of electrons in the flow-through reaction, and it is calculated as $n$=5 according to the following redox reactions between GaOOH and lithium ions：

$$GaOOH + 3Li^+ + 3e^- \rightarrow Ga + Li_2O + LiOH \qquad (2)$$

$$Ga + \frac{2}{7}Li^+ + \frac{2}{7}e^- \rightarrow \frac{1}{7}Ga_7Li_2 \qquad (3)$$

$$\frac{1}{7}Ga_7Li_2 + \frac{5}{7}Li^+ + \frac{5}{7}e^- \rightarrow GaLi \qquad (4)$$

$$GaLi + Li^+ + e^- \rightarrow GaLi_2 \qquad (5)$$

Substituting the above values into the formula(1):

$$C_{0(GaOOH)} = \frac{1000 * 5 * 96500}{3600 * 102.72} \approx 1304\ (mAh/g)$$

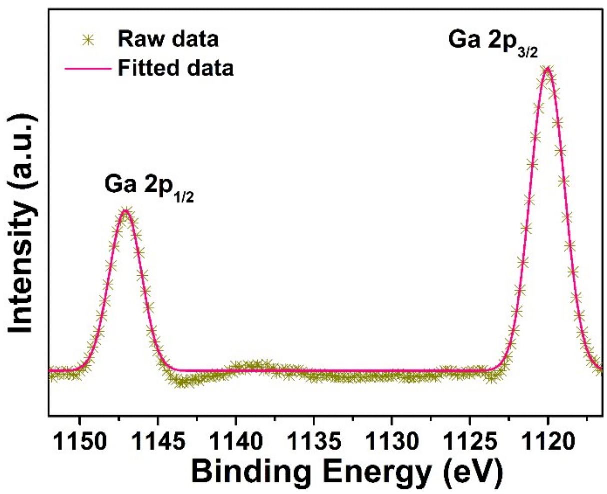


**Fig. S1** Ga 2p XPS spectrum of GaOOH nanorods.

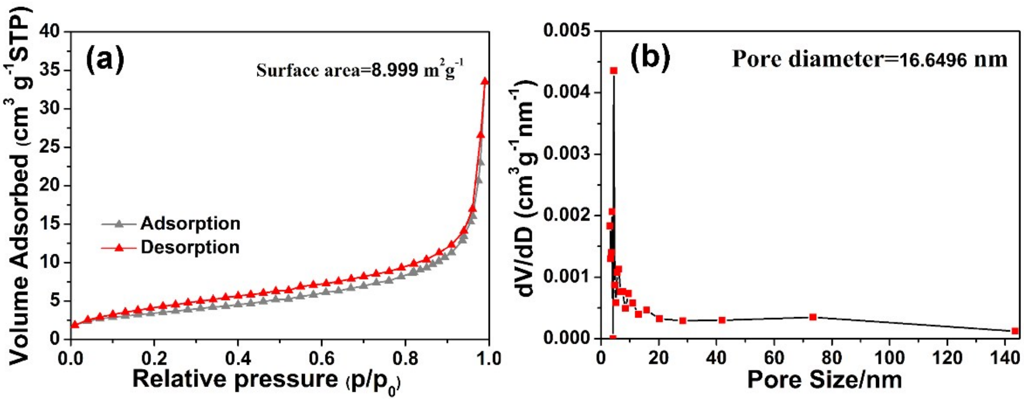


**Fig. S2** (a) $N_2$ adsorption−desorption isotherms and (b) pore size distribution curve of GaOOH nanorods.

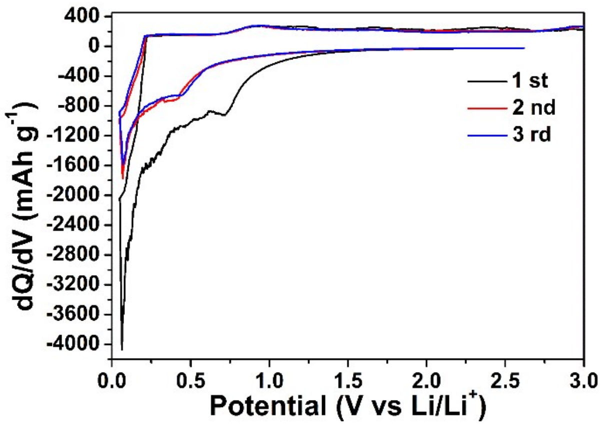


**Fig. S3** Plots of dQ/dV vs. potential for GaOOH nanorods.

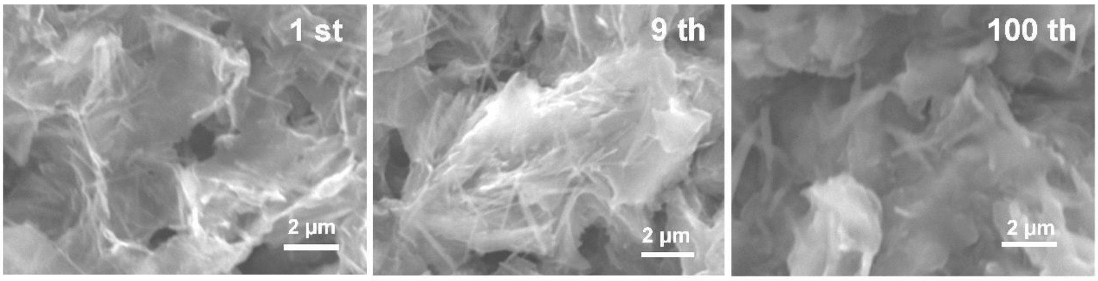


**Fig. S4** TEM images of the morphology of the products after $1^{st}$, $9^{th}$ and $100^{th}$ cycles.

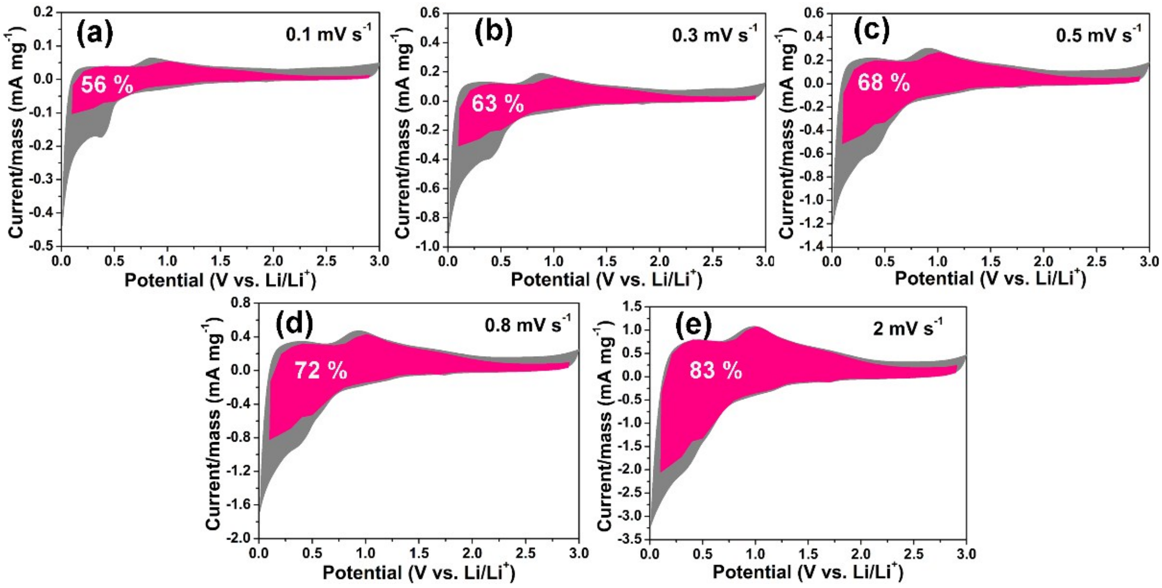


**Fig. S5** CV curves with the pseudocapacitive contribution shown by the red region at a scan rate of (a) 0.1 mV·s$^{-1}$, (b) 0.3 mV·s$^{-1}$, (c) 0.5 mV·s$^{-1}$, (d) 0.8 mV·s$^{-1}$and (e) 2 mV·s$^{-1}$.

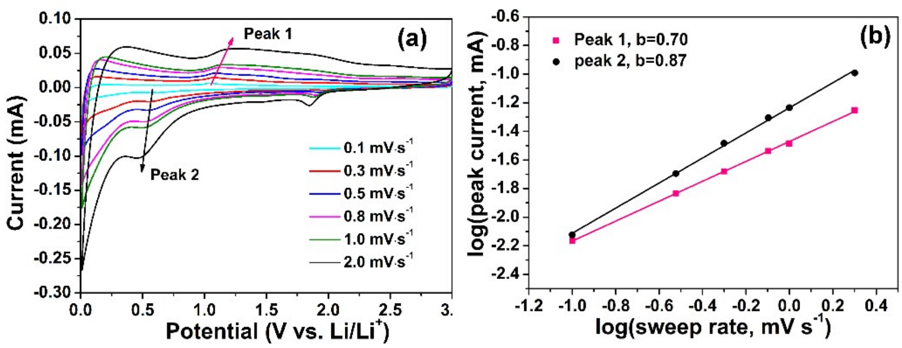


**Fig.S6** (a) CV curves at scan rates from 0.1 to 1.0 mV·s$^{-1}$ of GaOOH-super p; (b) corresponding logi vs. logv plots at each redox peak of GaOOH-super p.

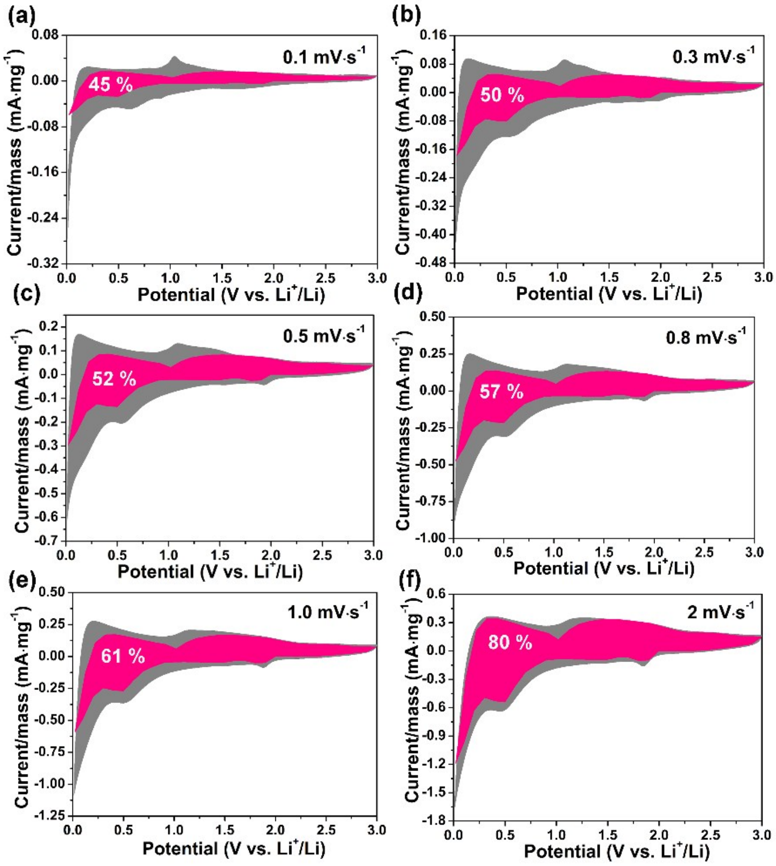


**Fig.S7** CV curves with the pseudocapacitive contribution for GaOOH-super p shown by the red region at a scan rate of (a) 0.1 mV·s$^{-1}$, (b) 0.3 mV·s$^{-1}$, (c) 0.5 mV·s$^{-1}$, (d) 0.8 mV·s$^{-1}$, (e) 1 mV·s$^{-1}$ and (f) 2 mV·s$^{-1}$.

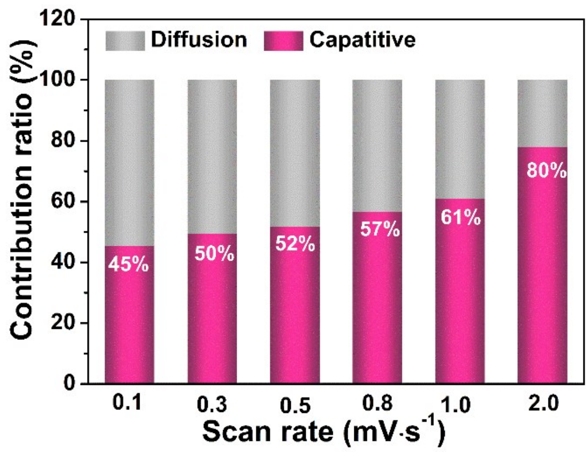


**Fig.S8** Normalized contribution ratio of GaOOH-super p at different scan rates.

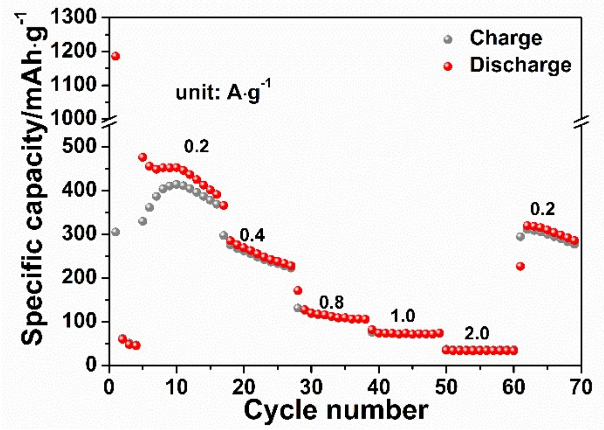


**Fig.S9** Rate performance of GaOOH-super p.

**Table. S1** Comparison of the characteristic parameters of different Ga-based materials for LIBs applications.

| Anode materials | Current desity (mA g$^{-1}$) | Cycling capacity (mAh g$^{-1}$) | Cycle number | Ref |
|---|---|---|---|---|
| GaN NSs | 1000 | 600 | 1000 | 1 |
| a-GaN@Cu | 10000 | 509 | 3000 | 2 |
| GaSe | 100 | 760 | 50 | 3 |
| $NiGa_2O_4$/rGO | 2000 | 669.8 | 1000 | 4 |
| ALD $GaS_x$ (x = 1.2) | 120 | 766 | 100 | 5 |
| $Ga_2S_3$ | 100 | 600 | 10 | 6 |
| $ZnGa_2O_4$ | 100 | 679 | 50 | 7 |
| $Ga_2O_3$@C@G | 100 | 458 | 50 | 8 |
| $Ga_2O_3$ NSs/rGO | 100 | 834 | 200 | 9 |
| $Ga_2O_3$-10% rGO | 50 | 770 | 40 | 10 |
| $Ga_2$O3@C NPs | 500 | 720 | 200 | 11 |
| **GaOOH nanorods** | **500** | **1089** | **300** | **This work** |

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