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

Supporting Information

ZnO Quantum Dots/Graphene Nanocomposites by Atomic Layer Deposition with High Lithium Storage Capacity

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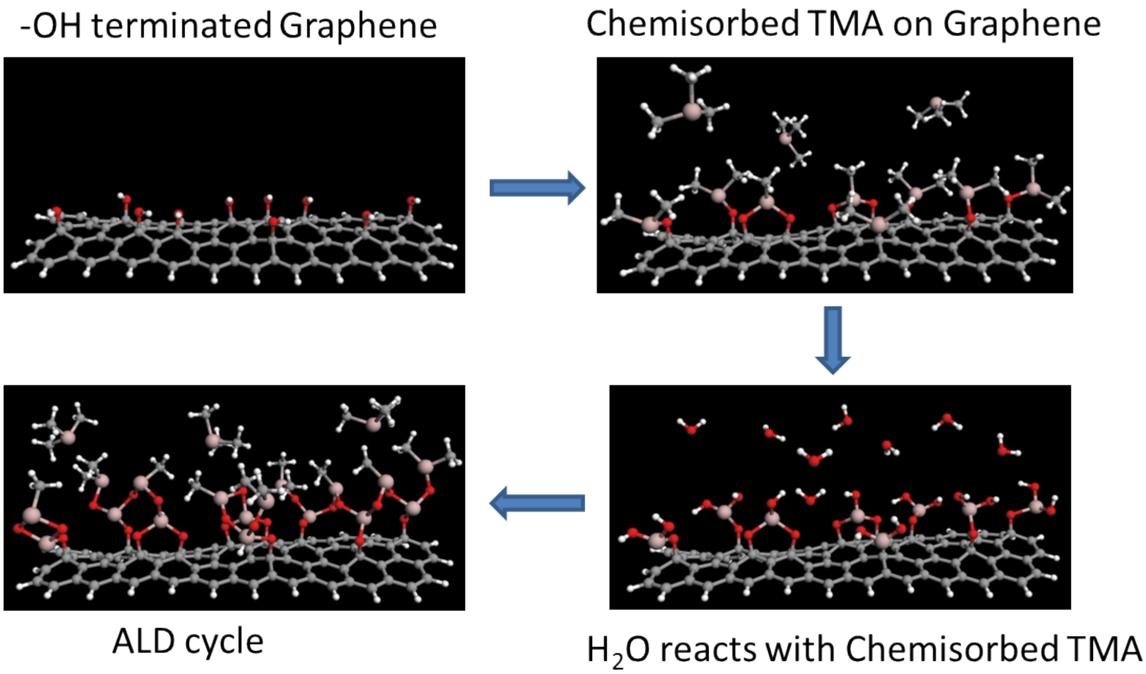
Table S1 \$/Ah for the common metal oxides estimated based on the price of their metal elements (\$/MT) and their theoretical capacity (Ah/kg).

Metal	Anode	\$/kg 3 month average	Theoretical Capacity (mAh/g)	\$/Ah
Al	Al*	2.13	993	0.0021
Zn	ZnO	2.21	978	**0.0022**
Mn	MnO_2	3.84	1232	0.0031
Mn	MnO	3.84	755	0.0051
Fe	Fe_2O_3	5.20	1005	0.0052
Fe	Fe_3O_4	5.20	925	0.0056
Cu	CuO	8.26	674	0.012
Mo	MoO_3	24.80	1117	0.022
Ni	NiO	18.38	718	0.026
Co	Co_3O_4	26.00	890	0.029
Mo	MoO_2	24.80	830	0.030
Sn	SnO_2	24.93	790	0.0316
Ti	TiO_2**	11.16	330	0.0338

[a] Prices obtained from MetalPrices.com, Winter 2013

*Al metal alloys with Li to form LiAl. Al_2O_3 is inactive to Li^+.

** TiO_2 intercalates/deintercalates with Li^+.



Schematic of ALD reaction

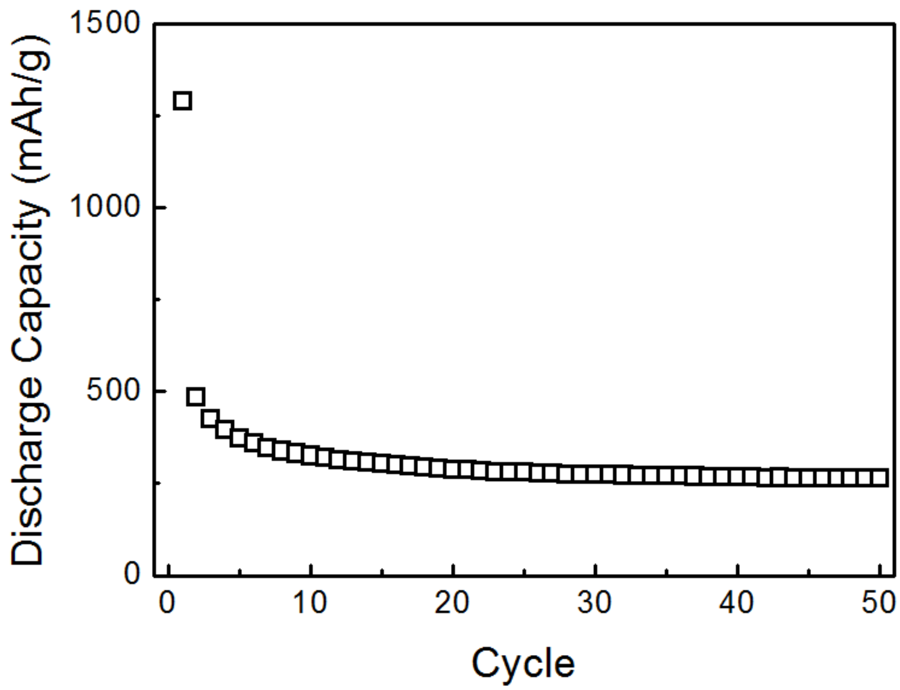


Figure S1 Cycling performance of 5 cycle ALD Al_2O_3 on graphene at 100 mA/g

Specific capacitance calculation of ZnO

We deposited 5 cycles of ALD Al_2O_3 on graphene to mimic the ZnO coverage at the defects and edge plane of graphene. Therefore, only intercalation between graphene layers will contribute to the capacitance of this composite. Figure S2 shows that the stable capacity of Al_2O_3-G after 50 cycles is only 258 mAh g^{-1}.

The capacity contribution of ZnO in the composite can be extracted after considering the real contribution from graphene (capacity of Al_2O_3-G), as following:

$$C_{ZnO} = \frac{C_{total} - C_{Al_2O_3-G} \times W_{Al_2O_3-G}}{W_{ZnO}}$$

Where, C_{ZnO}, C_{total}, $C_{Al_2O_3-G}$ are discharge specific capacitance of ZnO, ZnO-G composite, and ALD Al_2O_3-G, respectively. $W_{Al_2O_3-G}$ and W_{ZnO} are mass percentage of graphene and ZnO in the composites.

Therefore, for 15 ALD ZnO-G composite,

$$C_{ZnO} = \frac{C_{total} - C_{Al_2O_3-G} \times 0.573}{0.427}$$

and for 30 ALD ZnO-G composite,

$$C_{ZnO} = \frac{C_{total} - C_{Al_2O_3-G} \times 0.318}{0.682}$$