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Supporting Information

Al_2O_3 coated metal sulfides: One-pot synthesis and enhanced lithium storage stability via localized In-situ conversion reactions

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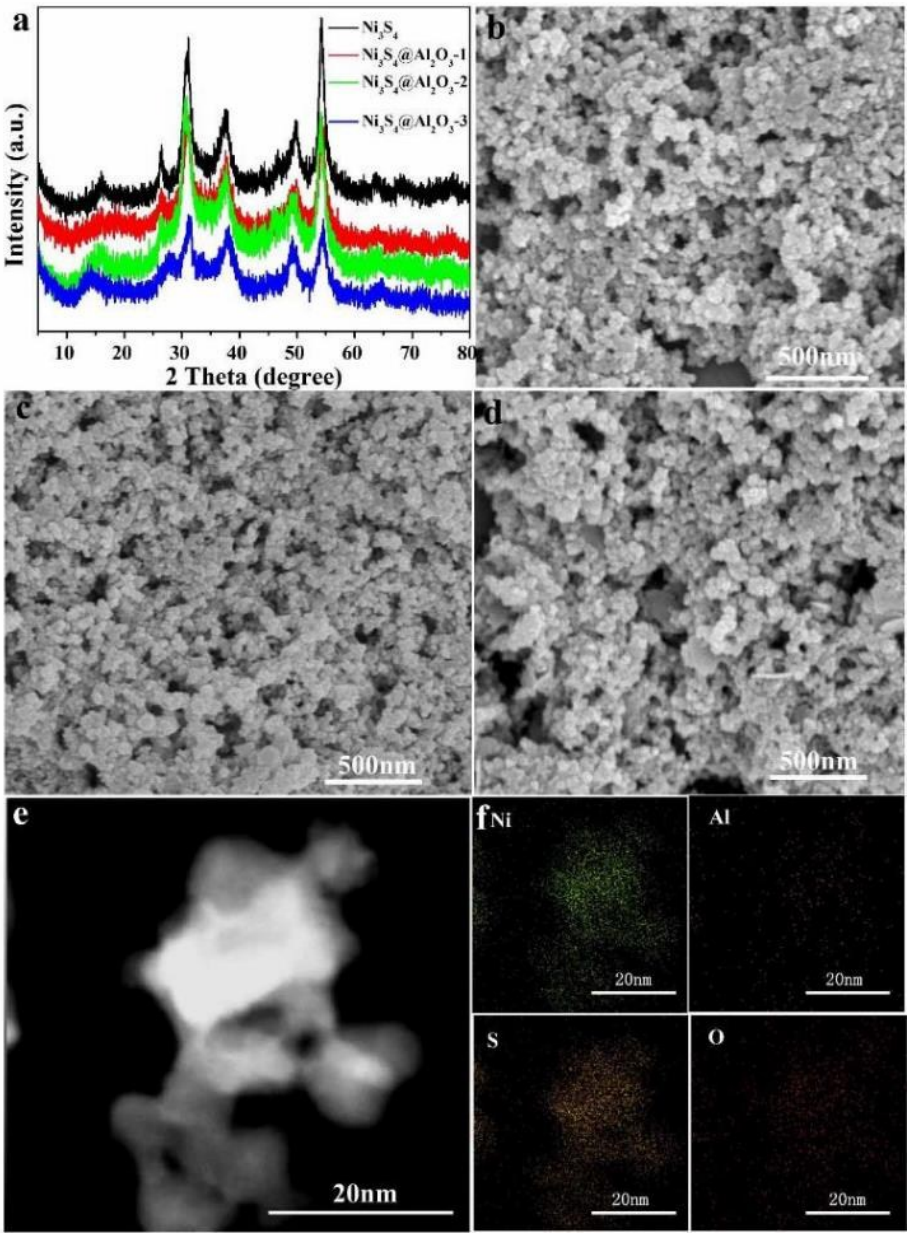

Figure S1. (a) XRD patterns of Ni_3S_4 and $Ni_3S_4@Al_2O_3$ composites, SEM of (b) Ni_3S_4, (c) $Ni_3S_4@Al_2O_3$-1, (d) $Ni_3S_4@Al_2O_3$-3. (e) HAADF-STEM image of $Ni_3S_4@Al_2O_3$-2 and (f) corresponding elemental mappings.

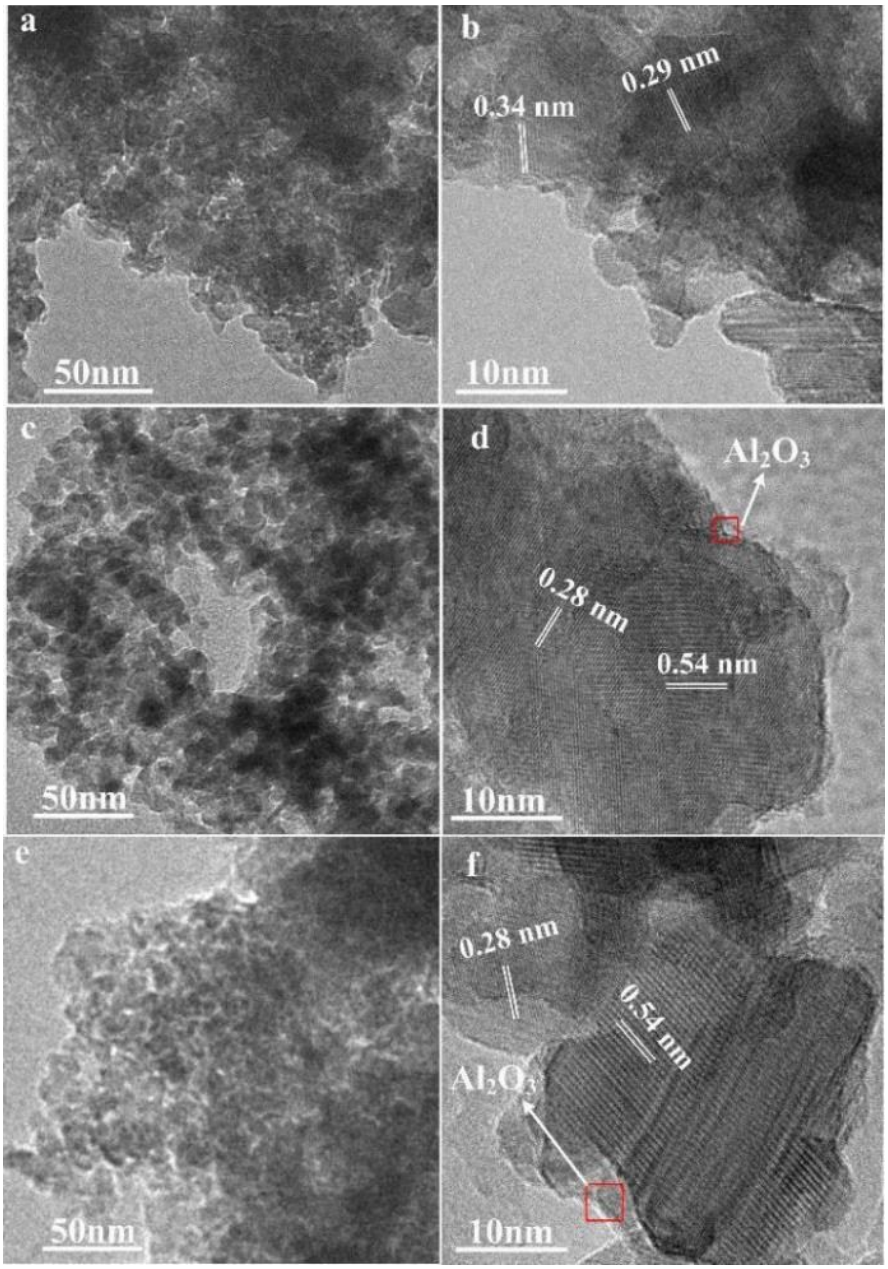

Figure S2. TEM image of as-prepared (a) Ni_3S_4, (c) Ni_3S_4@Al_2O_3-1, e) Ni_3S_4@Al_2O_3-3 and HRTEM image of (b) Ni_3S_4, (d) Ni_3S_4@Al_2O_3-1, (f) Ni_3S_4@Al_2O_3-3.

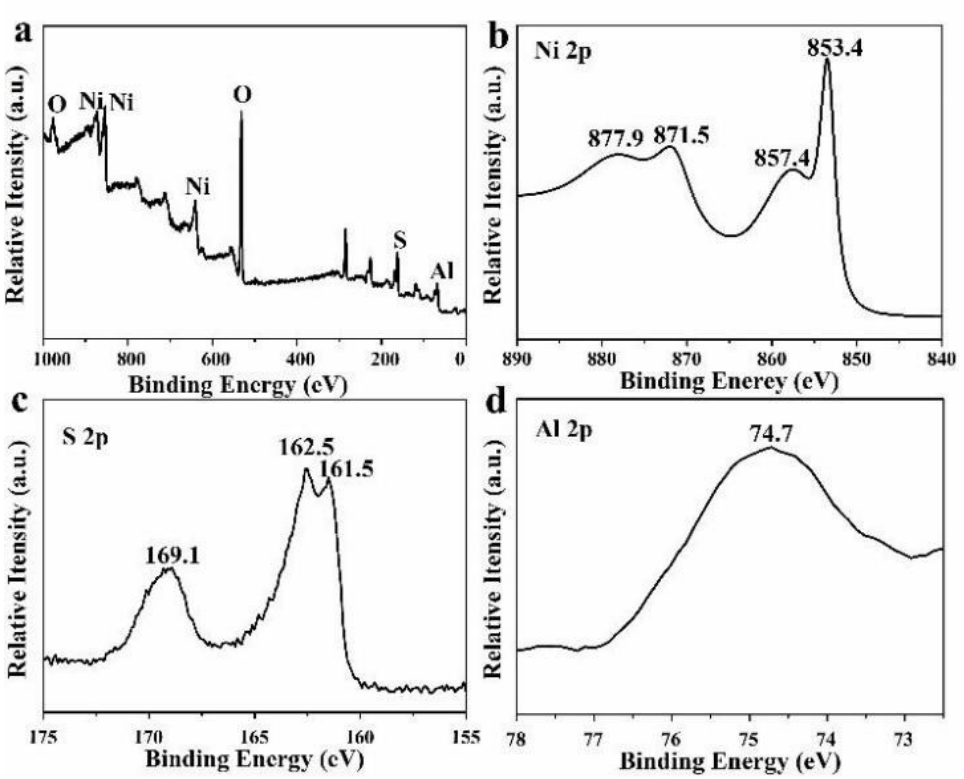

Figure S3. (a) XPS spectrum of Ni_3S_4@Al_2O_3-2, high-resolution spectra of (b) Ni 2p, (c) S 2p and (d) Al 2p, respectively.

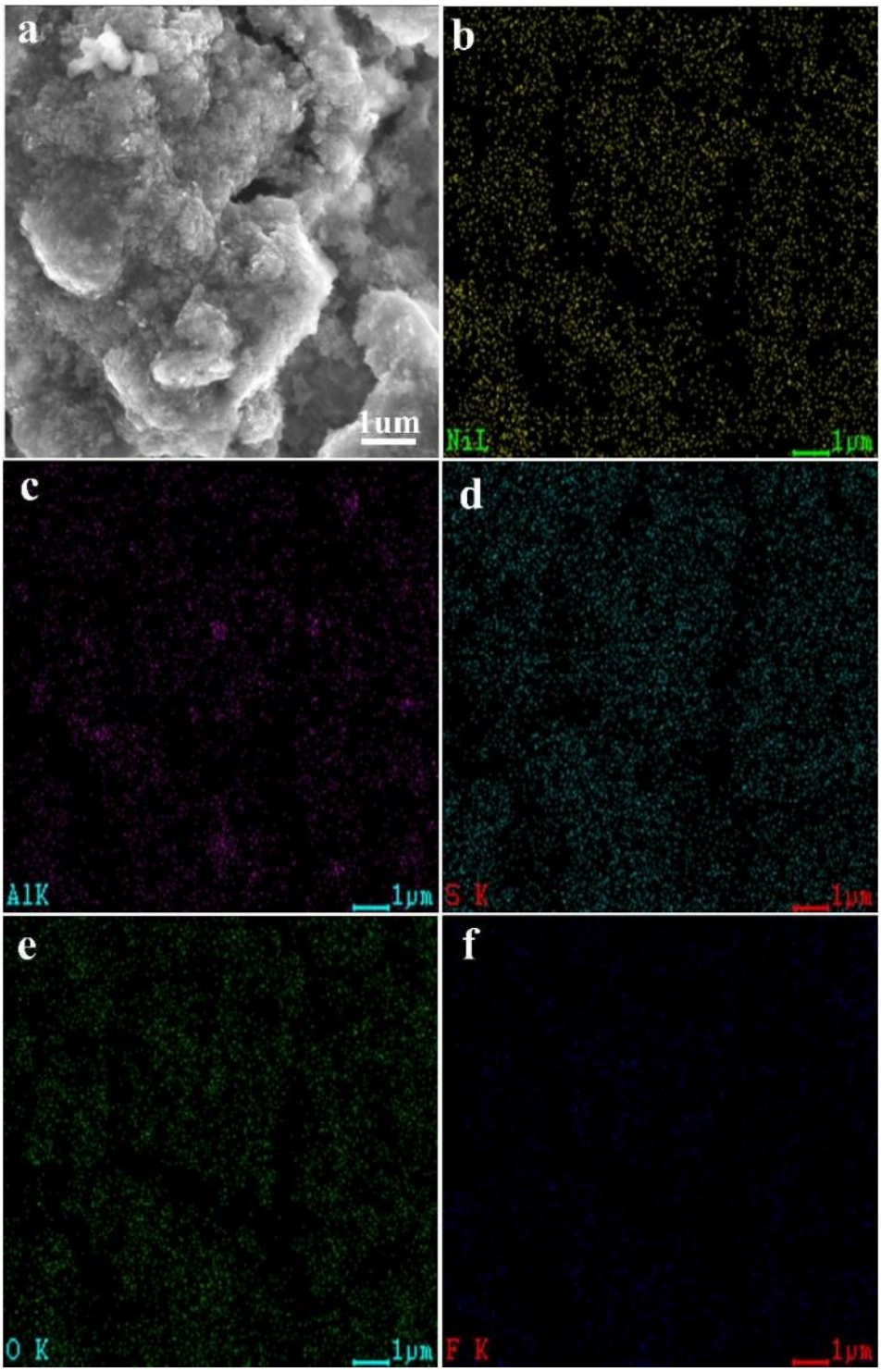

Figure S4. **FE-SEM** images (a) and corresponding elemental mapping of Ni (b), Al (c), S (d), O (e) and F (e) image of Ni_3S_4@Al_2O_3-2 nanocomposite electrode after being discharged/charged for 50 cycles at the current density of 500mA g^{-1} with the SEI film being removed.

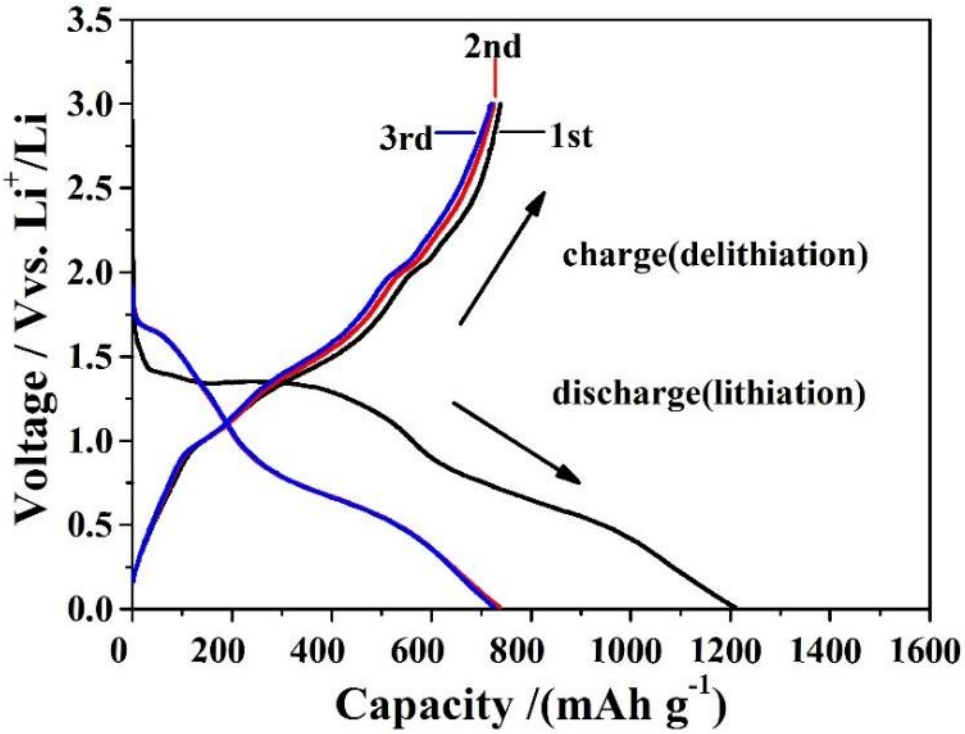

Figure S5. Charge/discharge voltage profiles (vs Li^+/Li) of the initial 3 cycles of $Ni_3S_4@Al_2O_3$-2 at 500 mA g^{-1}.

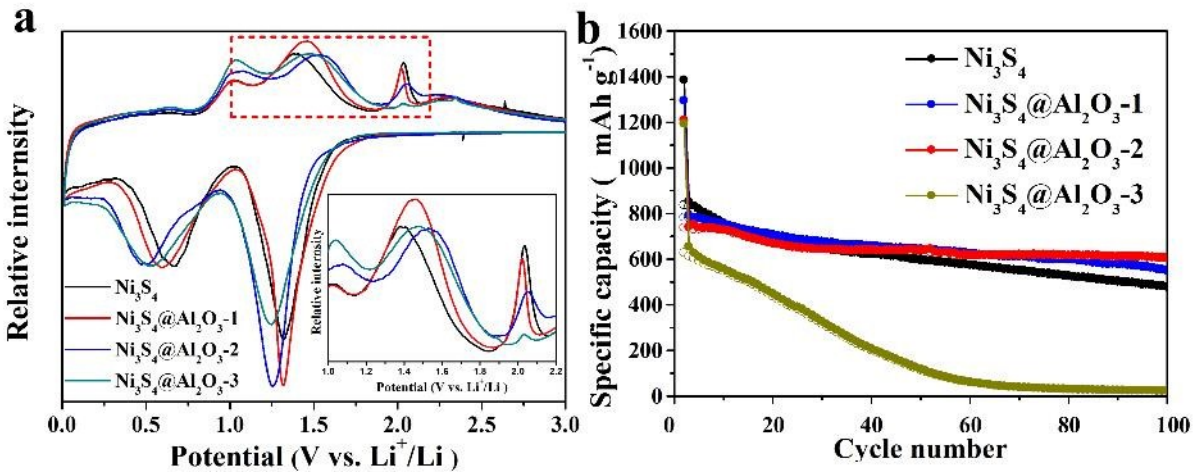

Figure S6. The 1st CV curves (a) and cycle performances (at 500 mA g^{-1}, b) of Ni_3S_4 and $Ni_3S_4@Al_2O_3$ between 0.01 V and 3.00 V.

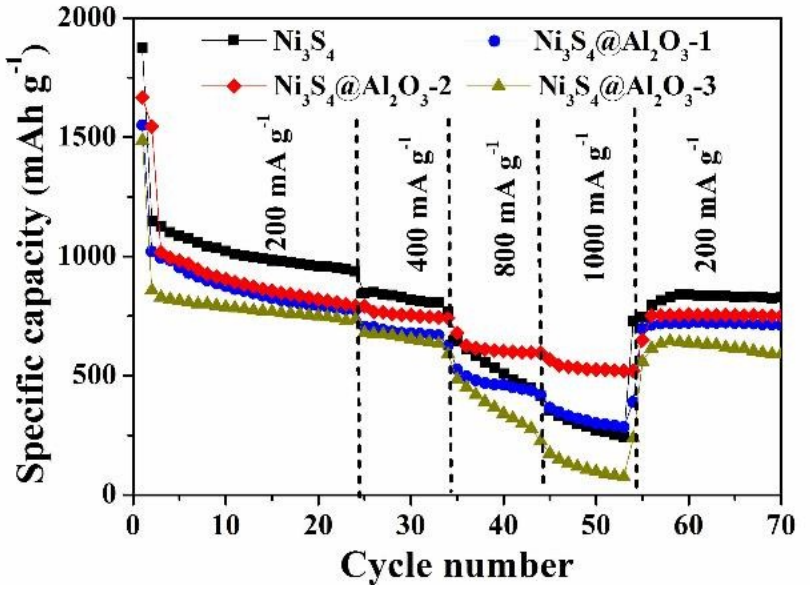

Figure S7. Different rate capacities of Ni_3S_4 and $Ni_3S_4@Al_2O_3$ anodes in the range of 200-1000 mA g^{-1}.

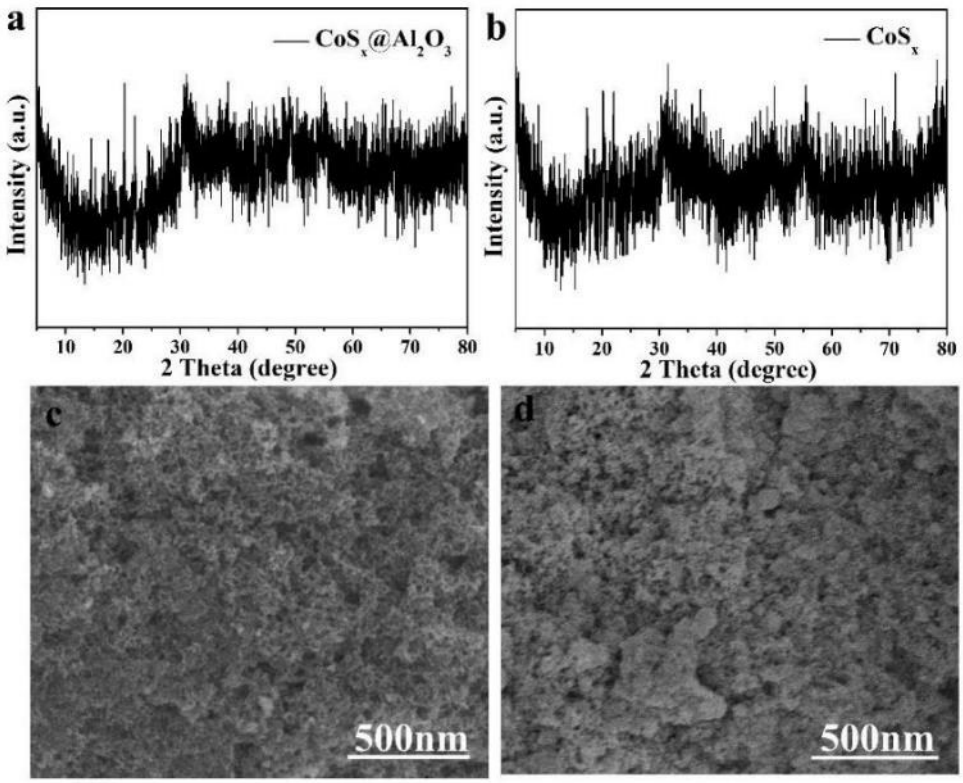

Figure S8. XRD patterns of (a) $CoS_x@Al_2O_3$ composites, (b) CoS_x, and corresponding SEM of (c) $CoS_x@Al_2O_3$ composites and (d) CoS_x.

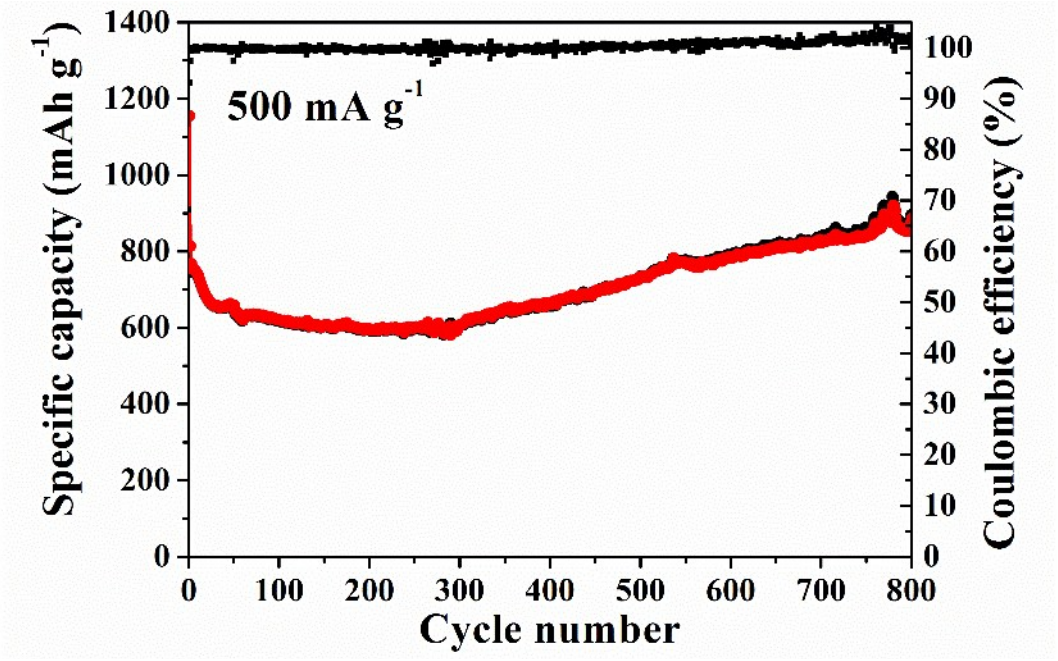

Figure S9. Cycle performances of $Ni_3S_4@Al_2O_3$ at 500 mA g^{-1} between 0.01 V and 3.00 V (vs Li^+/Li).