Ultra-Long cycle performance of NC-VN/MnO cathode for AZIBs based on relay type collaboration

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Introduction

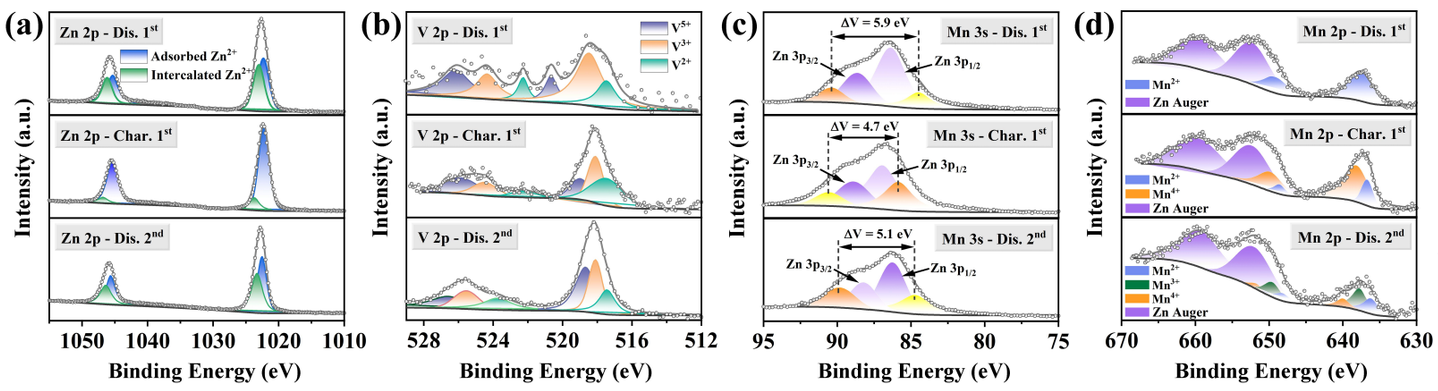
·NC@VN/MnO has a ultra-long lifetime resulting from a Mn/V relay type collaboration.

·At the early stage, MnO provides high capacity and VN prevent the aggregation of δ-MnO_2 nanosheets.

·At the later stage, VN provide additional storage sites and continue to maintain high capacity.

·The heterostructure and N-doped carbon improve the conductivity of Mn/V-based materials.

Reaction mechanism



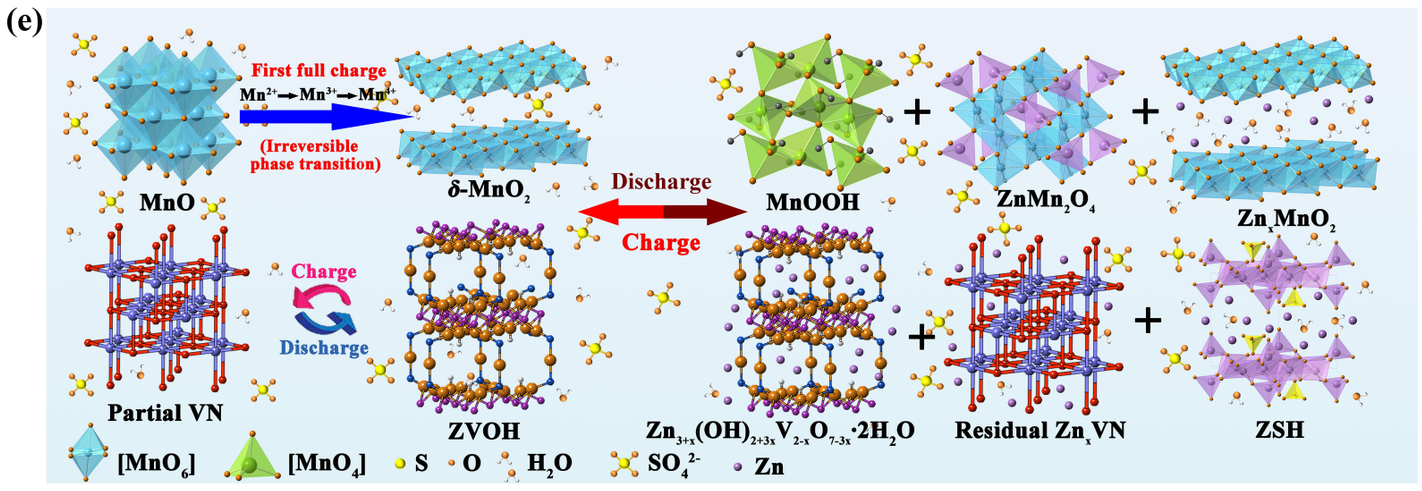


Fig. 1 Ex-situ high resolution XPS spectra of Zn 2p (a), V 2p (b), Mn 3s (c) and Mn 2p (d) in fully 1st discharged, 1st charged and 2nd discharged states of the NC@VN/MnO cathode, and Schematic illustration of phase transition mechanism (e).

Results

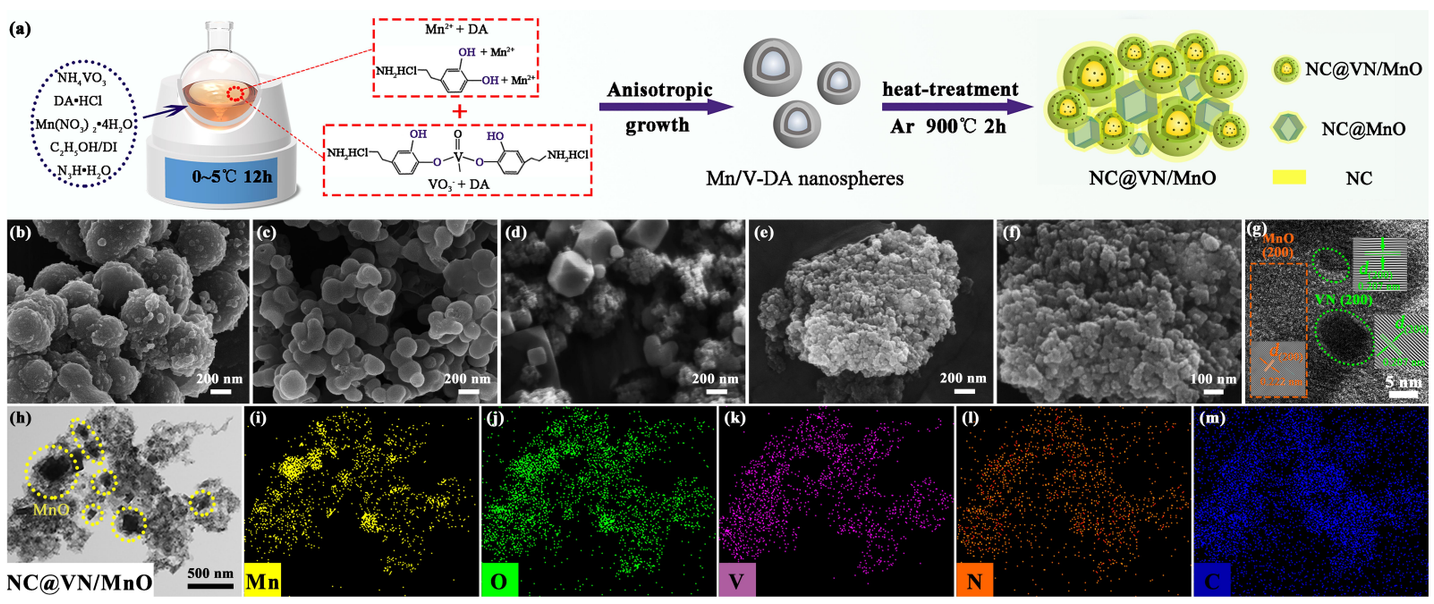


Fig. 2 Schematic illustration of synthesis of the NC@VN/MnO hybrid (a), FESEM images of the powders of NC (b), NC@VN (c), NC@MnO (d) and NC@VN/MnO (e-f), and HRTEM image (g) and EDS images of the NC@VN/MnO powder (h-m).

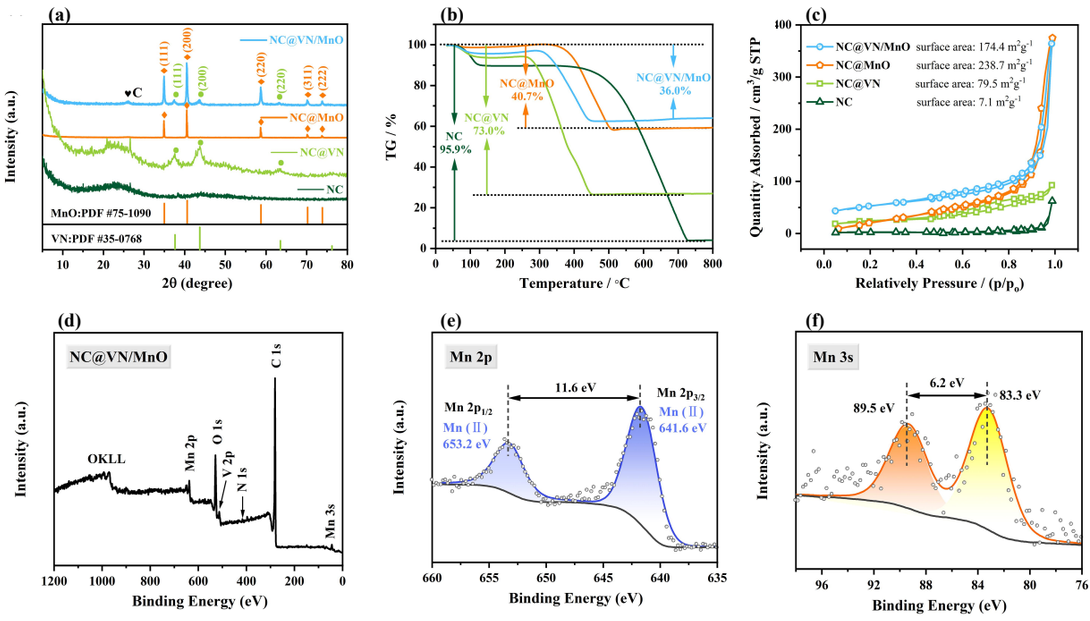


Fig. 3 XRD patterns (a), TG curves (b) and BET adsorption/desorption isotherms (c) of the NC@VN/MnO, NC@MnO, NC@VN and NC powders, and XPS spectra of survey scan of NC@VN/MnO(d), Mn 2p (e) and Mn 3s (f).

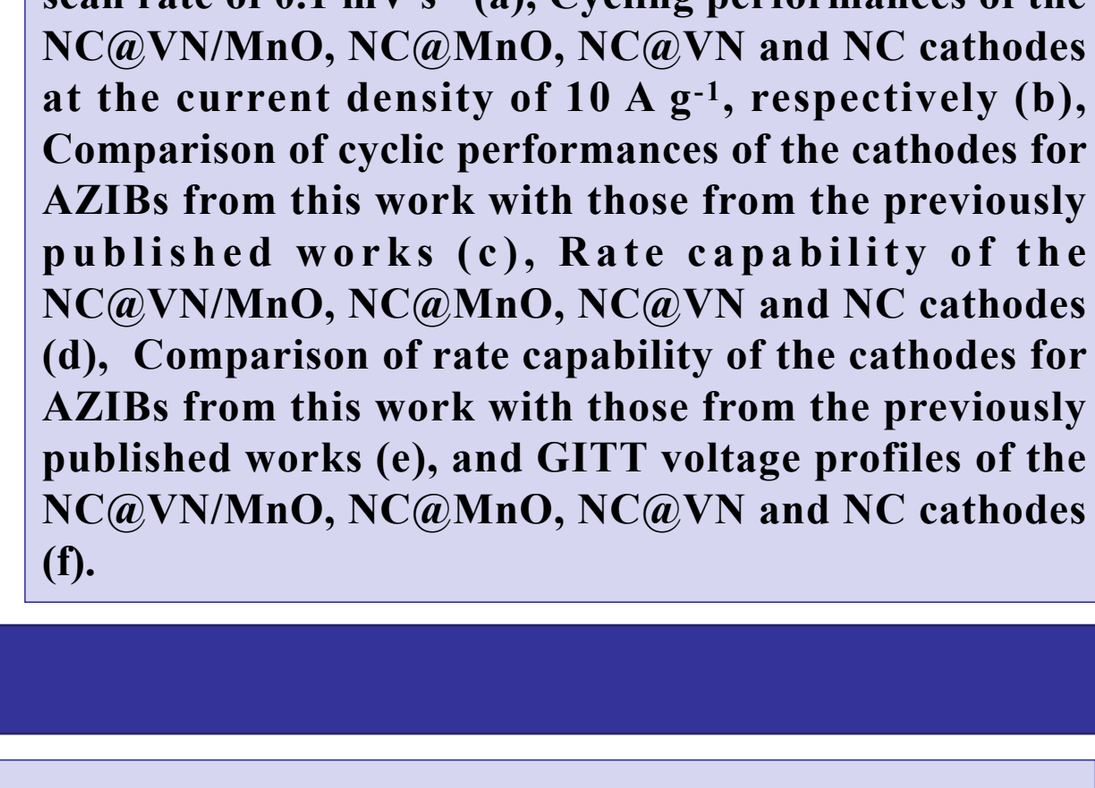


Fig. 4 CV profiles of the NC@VN/MnO electrode at a scan rate of 0.1 mV s^{-1} (a), Cycling performances of the NC@VN/MnO, NC@MnO, NC@VN and NC cathodes at the current density of 10 A g^{-1}, respectively (b), Comparison of cyclic performances of the cathodes for AZIBs from this work with those from the previously published works (c), Rate capability of the NC@VN/MnO, NC@MnO, NC@VN and NC cathodes (d), Comparison of rate capability of the cathodes for AZIBs from this work with those from the previously published works (e), and GITT voltage profiles of the NC@VN/MnO, NC@MnO, NC@VN and NC cathodes (f).

Conclusions

The cooperation of MnO and VN is essential for achieving long cycle lifetimes of the NC@VN/MnO cathode in two main ways.NC@VN/MnO outputs a capacity of 108.3 mAh g^{-1} at 10 A g^{-1} after 12000 cycles. Hence, this hybrid material with relay type of energy storage mechanism can continue to maintain the ultra-long lifetime of AZIBs. This work provides a new idea to design and construct other cathode materials with excellent electrochemical performance for AZIBs.