The Superior Role of Manipulating Oxygen Vacancies in Perovskite $SrTiO_3$ Before and After Doped With Transition Metal as Cathode for Rechargeable Alkaline Zinc Battery

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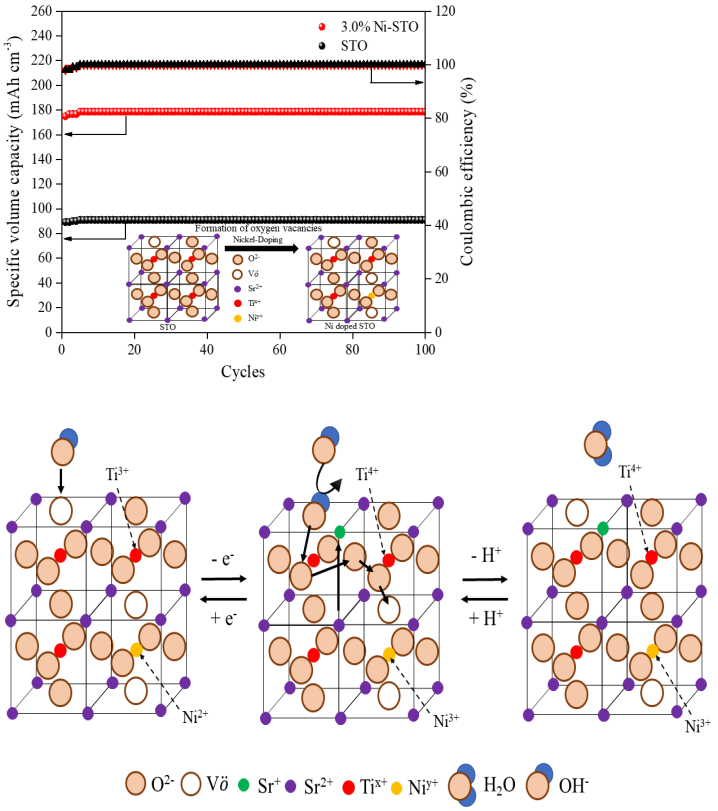
Abstract

Rechargeable alkaline zinc batteries (RAZBs) are promising aqueous battery due to the advantages of Zn metal as the anode. Although the Zn anode is low cost, non-toxic, and intrinsic safety, the use of metal oxide cathode suffers from poor discharge capacity and energy density in RAZBs. The preparation of $SrTiO_3$ and doped $SrTiO_3$ as cathode has successfully improved the performance of RAZBs. The RAZBs performance is according to this order as follows: 5.0% Mn-STO (744 mAh cm-3) > 1.0% Al-STO (646 mAh cm-3) > 3.0% Ni-STO (596 mAh cm-3) > STO (387 mAh cm-3). The cyclability of RAZBs maintained 100% of its initial capacity after 100 cycles. This is attributed to the metal doping increased the conductivity and oxygen vacancies ($V\ddot{o}$) of pristine STO. Ti sites in STO are partially filled by dopant atoms leading to the formation of oxygen vacancies. The manipulation of $V\ddot{o}$ play an important role in the electrochemical performance of RAZBs as it provides more active sites for charge storage. Redox reaction of Mn also contributed to the specific capacity of RAZB. High energy density of 90 mWh cm-3 was obtained in doped Mn-STO cathode showing the potential of RAZBs.



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