

Characterization of Mossy Zinc Electrodeposits

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Although zinc has been widely used in zinc-air and secondary alkaline batteries, zinc deposition in alkaline solutions is still not fully understood. Of three types of deposit structure - dendritic, compact, and mossy, mossy zinc has been the least studied in spite of its atypical crystal structure and interesting properties. In this study, zinc was deposited onto polycrystalline and single crystal zinc electrodes from an alkaline zincate solution. The morphology of deposits was studied using SEM, field emission SEM, TEM, and XRD. The composition and specific surface area of mossy zinc was determined using EDX and BET analysis, respectively. The electrode-electrolyte interface was investigated using AC impedance spectroscopy, and galvanostatic, potentiostatic, potentiodynamic techniques.

Electrodeposited mossy zinc is blackish powder consisting of tangled filaments or whiskers which have a diameter of 100 - 200 nm, and with a BET specific surface area of more than 5 m²/g. Mossy zinc develops at current densities lower than 15 mA/cm². The deposition conditions favouring mossy zinc are high temperature, high zincate concentration, a stirred solution, and a surface which provides more nucleation centers. The mossy formation is under activation control in contrast to diffusion controlled dendritic growth. Some common inhibitors, which are able to block kink sites, inhibit mossy development, while a few additives facilitated mossy development.

Mossy zinc develops selectively on certain grain orientations while dendritic growth is much less dependent on substrate orientation. Mossy deposits initially grow in the [0001] direction. After a certain length, the growth changes to other directions including [10̄10], [01̄10], and [2̄1̄10].

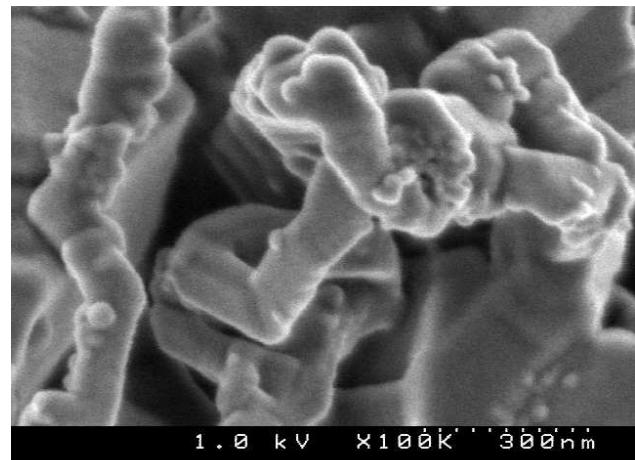


Fig. 1. Filaments of mossy zinc deposits