Enhancing the cycling stability of zinc anodes with anion-exchange ionomer

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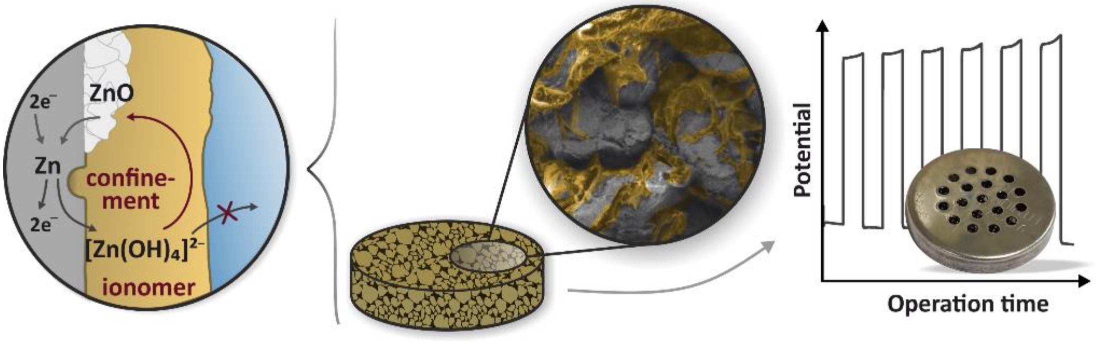
Advantages of secondary Zn-based batteries are low cost, abundancy and recyclability. Particularly, Zn-air batteries become a promising candidate for energy storage in electronic applications combining high specific energy density, environment friendliness and safe operation. However, secondary Zn-based batteries possess limited cycling stability due to one major issue at the anode: the high solubility of oxidized zinc species in the alkaline electrolyte results in electrode shape change and leads eventually to the loss of active material during repeated discharge and charge.[1]

We apply a homogeneous coating with an anion-exchange ionomer on top of the Zn surface to confine oxidized zinc species that are produced during discharge. Ideally, the confinement of oxidized zinc species as zinc oxide interlayer reduces the shape change of the electrode and keeps the active material as close as possible to the place of its origin.

We perform cyclic voltammetry measurements on Zn model anodes with anion-exchange ionomer coating to show that the loss of oxidized zinc species into the bulk electrolyte during zinc dissolution can be efficiently avoided with our approach, leading to an increased amount of restored zinc during zinc deposition. In addition, X-ray photoelectron spectroscopy depth profiling experiments prove the formation of a zinc oxide interlayer between anion-exchange ionomer and zinc electrode.

Based on our confinement concept, we derive a structured Zn anode with three-dimensional pore system and incorporated anion-exchange ionomer. Electrochemical cycling experiments in combination with operando X-ray diffraction measurements imply that the novel Zn anode is electrically rechargeable up to 18 cycles at more than 25 % depth of discharge.

All in all, applying an anion-exchange ionomer coating to the Zn electrode highlights the benefit of ion-selective electrode coatings to improve their cycling stability.



References:

[1] J. Fu, Z. P. Cano, M. G. Park, A. Yu, M. Fowler, and Z. Chen, “Electrically Rechargeable Zinc–Air Batteries: Progress, Challenges, and Perspectives,” *Adv. Mater.*, vol. 29, no. 7, p. 1604685, Feb. 2017.