HYDROBAT - Boride-derived Highly Efficient Material for Green Hydrogen Generation and Zn–air Battery

The world energy demand is expected to grow by more than 25% by 2040, according to the world energy outlook by the International Energy Agency. To tackle this significant and urgent challenge new materials with engineered properties for energy applications are required. Hydrogen (H2) production by water electrolysis (Green H2) has received great interest as an alternative sustainable and clean energy technology. For instance, the green H2 is very crucial for the European Commission's net zero emissions scenarios for 2050. To achieve green H2, this technology should be coupled with intermittent and renewable energy sources. And thus, the energy storage devices are involved in the green H2 production system. Due to its high energy density, and environmentalfriendly, the Zinc-air battery is regarded as important energy storage device in the near future. But, the lack of satisfactory cheaper bifunctional electrocatalysts (ECs) for Hydrogen Evolution Reaction (HER) and oxygen evolution reaction (OER) for water electrolysis and the lack of bifunctional air ECs for oxygen reduction reaction (ORR) and OER are the main challenges for both these technologies. The state-of-the-art ECs are based on noble metals, whose application at a large scale is limited due to their high cost and scarcity. Consequently, the development of highly efficient ECs without precious metals is urgent. Current strategies for the development of desirable earth-abundant materials are often limited because of the poor electron transfer, low conductivity, poor stability, and small surface area of the active materials. To tackle this challenge, we aim (1) to develop hybrid materials based on earth-abundant metals derived from boride and highly conductive carbon by chemical reduction and pyrolysis methods, (2) to study their structure-property relationship, and finally, (3) to understand the degradation mechanism which is crucial for designing the materials with outstanding stability.

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