Li-ion battery recycling waste as highly valuable raw material for the synthesis of active oxygen electrocatalysts

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The rapid growth of Li-ion battery (LIB) usage, fueled by demand from electronics, electric vehicles, and renewable energy systems, emphasizes the urgent need for sustainable battery lifecycle management While current recycling processes effectively retrieve valuable metals like Co, Ni, and Cu, graphite, a fundamental component constituting up to 25 wt% of the battery, is disregarded and disposed of through incineration. This practice is neither environmentally sustainable nor economically viable. Thus, it is imperative to innovate strategies to recover spent graphite from batteries and repurpose it for novel energy storage and conversion technologies to prevent the loss of this valuable resource.

In our research, we have demonstrated the viability of utilizing used battery graphite as a valuable raw material for the synthesis of graphene oxide (GO). We have successfully converted battery-derived GO into nitrogen-doped reduced graphene oxide, showcasing high catalytic activity towards the oxygen reduction reaction in alkaline media.[1] Furthermore, we extend this innovative approach to industrial graphite rich recycling waste, leveraging it as a primary material for producing bi-functional oxygen electrocatalysts (Fig.1). By exploiting the transition metal residue inherent in the graphite waste, we have achieved in-situ metal doping of our battery-derived electrocatalysts.[2] These novel electrocatalysts exhibit significant potential for applications in Zn-air batteries and regenerative fuel cells. Our findings underscore the value of repurposing neglected LIB recycling waste fractions for electrocatalyst production, contributing to the advancement of sustainable energy technologies.

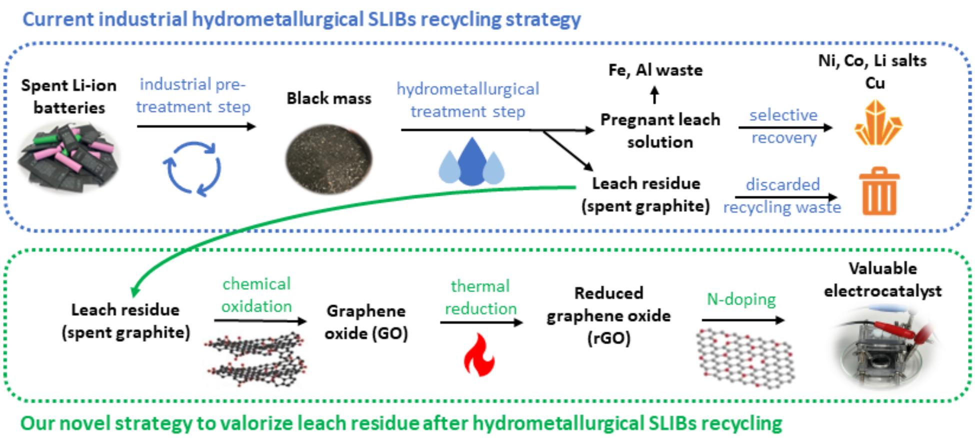

Figure 1: Schematics of the "state-of-the-art" industrial hydrometallurgical SLIBs recycling pathway and our novel strategy for producing valuable electrocatalyst

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