Nano-Catalysts Decorating Graphite Felts as High-Performance Electrodes for an All-Vanadium Redox Flow Battery

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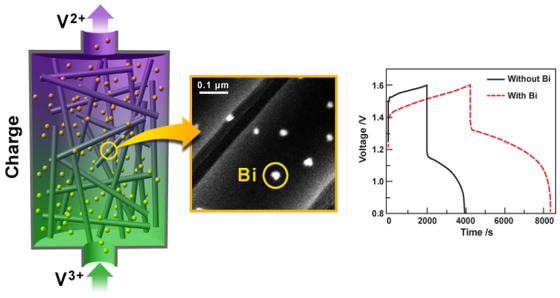
Redox flow batteries (RFBs), as one of the most promising electrical energy storage systems, provide an alternative solution to the problems of balancing power generation and consumption. RFBs are designed to convert and store electrical energy into chemical energy and release it in a controlled fashion when required. Of them, all vanadium system (VRBs), utilizing vanadium-containing chemicals as positive V(IV)/V(V) and negative V(II)/V(III) electrolytes, is one of the most promising redox systems due to its high efficiency.[1] Especially, recently invented mix-acid based all vanadium system by Li and co-workers[2] at PNNL largely improved the energy density and temperature stability window of vanadium electrolytes. In addition to the improvement of energy density, another way to effectively reduce the VRB cost is to increase the current density, which directly leads to a smaller stack size, therefore dramatically reduce the cost.

Here we report two kinds of novel low-cost nanocatalysts decorating graphite felts (GF) as VRB electrode with significantly improved energy efficiency (EE) especially at high current density.[3] It is shown that the modified GF electrode greatly improved the electrochemical activity of V(IV)/V(V) and V(II)/V(III) redox couples, leading to the large reduction of overpotential. Consequently, the EE value reached 78% for the electrolytes with the optimized amount of catalyst at the current density of 150 mA/cm^2, which increased by 10~12 % as compared with that without an electrocatalyst. These results suggest catalyst modification of GF surface is a promising route to improve the energy efficiency of VRBs especially under high- current-density operation.



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