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Sulfur-doped Cobalt Oxide Nanowires as Efficient Electrocatalysts for Iodine Reduction Reaction

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Abstract: Sulfur-doped cobalt oxide (S-Co_3O_4) crystals exhibit excellent catalytic activities towards multiple useful reactions, however, the impact of the structural properties on the resultant catalytic activities has been overlooked in the past. We demonstrate a facile vapor-phase hydrothermal (VPH) doping approach to effectively create electrocatalytically active surface sulfur species on the chemical bath deposited polycrystalline Co_3O_4 nanowires for iodine reduction reaction (IRR). The dye-sensitized solar cells (DSSCs) equipped with the S-Co_3O_4 nanowire film as the counter electrode (CE) achieve a best energy conversion efficiency of 6.78%, which is comparable to those of DSSCs with commercial Pt CE (7.36%). The impact of film structure, VPH temperature and VPH duration on the resultant structures as well as the electrocatalytic activities has been comprehensively studied. More importantly, our results manifest a close correlation between the surface sulfur dopant level and the key electrocatalytic activity indicators. The VPH approach could be further extended to the fabrication of low-cost, high-performance nanomaterials for energy conversion applications.