ELECTRODEPOSITION OF CHALCOGENNIDE MATERIALS

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Electrodeposition has been attracting attentions because of its many advantages including low-cost, rapid deposition rate, and ease of control their microstructure and crystallinity by adjusting electrodeposition parameters. Among many materials, of II-VI semiconductors, including binary and ternary compounds can be used either alone or by alloying with other elements, for solar cells, photoelectrochemical cell (PEC), thermoelectric devices, and phase-change devices. Among many applications, we studied the possibility of chalcogenide to thermoelectric and photoelectrochemical materials.

Thermoelectric compounds such as Sb_2Te_3, Bi_2Te_3, and Bi_2Se_3 have been extensively studied because of their potential applicability for efficient energy harvesting and coolingdevices. In addition, we synthesized 3D Te-Si heterostructures with controlled shapes and morphologies by combining two electrochemical methods, namely, the selective metal-assisted chemical etching of Si to form Si nanotrunks and a galvanic displacement reaction of Si to form Te branches or nanoleaves, under ambient conditions. Unlike other synthesis methods, these processes are highly scalable and compatible with conventional Si processes. In addition, preliminary experiments on PECs based on the fabricated nanostructures indicated that the hyperbranched heterostructures are highly efficient active materials because of their ability to decouple the directions of light absorption and charge-carrier collection.