Synthesis of ZnO/WS_2 and ZnS/MoS_2 core-shell nanowires and possible applications

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Core−shell nanowires (NWs) are modern types of radially heterostructured nanomaterials intensively explored during the last decades. The core−shell approach has several important advantages as compared to conventional two-dimensional (2D) Transition Metal Dichalcogenides (TMD) material production technologies: it allows one, for example, to combine materials with lattice mismatch and even to initiate epitaxial growth of shell material on the core template. As a result, it is possible to significantly improve electrical, mechanical, and optical properties of NWs by proper combination of core and shell materials.

In this work, we synthesized of ZnO/WS_2 [1,3] and ZnS/MoS_2 [2,4] core-shell nanowires using two-step approach. A synthesis was performed by annealing in a sulfur atmosphere of ZnO/WO_3 or ZnO/MoO_3 core−shell nanowires, produced by reactive dc magnetron sputtering of an amorphous a-WO_3 or a-MoO_3 layer on top of ZnO nanowire array. The morphology and phase composition of synthesized core−shell nanowires were confirmed by scanning and transmission electron microscopy (SEM and TEM), micro-Raman, and photoluminescence spectroscopy.

ZnO/MoS_2 core-shell nanostructures could potentially be applied for photocatalytic hydrogen evolution reaction [5]. Fast-response single-nanowire photodetector based on ZnO/WS_2 core-shell heterostructures was produced by our group [3], demonstrating the potential of combining 2D TMDs materials with semiconducting nanowires for optoelectronic applications.

References

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