Hydrothermal Synthesis of ZnO Nanorod Cluster Thin Films for Low-Dimensional Thermoelectric Applications

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The problem of waste heat recovery is found everywhere from electricity generation from fuel sources to heat transport through pipes along with heat dissipation in microelectronics. Thermoelectric generators have sparked considerable interest as they are able to convert heat into electricity via the Seebeck effect. Despite having no moving parts and being environmentally-friendly, they perish from low conversion efficiencies. Research into nanostructures has shown potential in improving the efficiency of these devices and implementation in low-dimensional applications. In this investigation, hydrothermally-synthesized ZnO nanorods thin films on FTO substrates were evaluated in terms of the thermoelectric properties to address the question: will the synthesis of ZnO nanorods thin films function as an effective thermoelectric material? To evaluate the thermoelectric figure of merit, expressed as ZT=S2GT/κ the Seebeck coefficient using a linear gradient method. The electrical properties of the film were measured to determine the range of tis electrical conductivity. The film's morphology was evaluated to determine the properties resulting from the formation of nanostructures. The synthesis resulted on the formation of a novel morphology: ZnO nanorod clusters. The ZnO thin films exhibited varying Seebeck coefficients on the order of 10μV/K. additionally, the morphology of the film indicated a lower electrical conductivities than other nanostructures. The cluster-like structure of the ZnO nanorods. Furthermore, this aspect was confirmed by the evaluation of the ZnO nanorods' sheet resistance which proved to be considerably high. It was asserted that ZnO nanorods have the potential to be used in thermoelectric applications.