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Thermoelectric properties of Bi_2Te_3 films and nanowire arrays CHENG LUNG CHEN, YANG YUAN CHEN, P. C. LEE, C. T. CHEN, S. R. HARUTYUNYAN, S. J. LAI, C. D. CHEN, S. J. LIN, INSTITUTE OF PHYSICS, ACADEMIA SINICA TEAM — The n-type Bi_2Te_3 nanowire arrays with diameter $\sim$120 nm and thin films with thickness $\sim$10 μm have been fabricated by electrochemical deposition from nitric acid bath, containing bismuth nitrate and tellurium dioxide. Extensive characterizations of the morphology, structure, and composition of the films and nanowires were performed by means of SEM, XRD, EDS, and TEM. The films have nanocrystalline structure whereas the nanowires are single crystallines. The influence of microstructure on thermoelectric properties was investigated by comparison charge carrier transport in two mutually perpendicular crystallographic directions. The measurements of Seebeck coefficient and electrical resistivity were carried out in temperature region of 180 to 300 K. The highest value of σS^2 = 840 μW/m-K^2 was obtained at 285 K for film. The electrical resistivity of an individual Bi_2Te_3 nanowire is $\sim$4.3 $\mu\Omega$-m using e-beam lithography technique. Based on the Seebeck coefficient obtained from nanowire arrays, the calculated value of σS^2 for single nanowire is $\sim$1000 $\mu Wm^{-1}K^{-2}$ which is higher than that of the film. These results may help in designing processes for thermoelectric microdevices.

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