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Energy-saving fabrication of Ag2Te-Te and $Co_{1-x-y}Ni_xFe_y$ thermoelectric materials

Thermoelectric materials can be used to generate electricity from waste heat via the Seebeck effect. High-energy input is often required to fabricate thermoelectric materials. In this talk, we present a green route to synthesize Ag_2Te-Ag nanocomposites with the reaction taking place in one pot at room temperature without any organic substance involved. Various amounts of silver in the Ag_2Te-Ag nanocomposite can be obtained depending on the reaction period of time. A possible mechanism is presented for the formaiton of Ag_2Te-Ag nanocomposite. A core-shell structure at the incipient stage of Ag_2Te growth can be observed. However, the reaction duration has a significant effect on the electrical transport behavior of the nanocomposites due to presence of various amounts of Ag, which might be beneficial for enhancing the performance of thermoelectric composites. We also present a rapid route for fabricating co-doped $Co_{1-x-y}Ni_xFe_ySb_3$ using hydrothermal methods. Hydrothermal synthesis was carried out at 170°C for a duration of 12 h, followed by evacuated-and-encapsulated heating at 580°C for a short period of 5 h. The resulting samples are characterized using powder X-ray diffraction, density, electronic and thermal transport measurements. Due to the bipolar effects on thermopower are shifted to higher temperatures as compared with the nondoped $CoSb_3$, the power factor of $Co_{1-x-y}Ni_xFe_ySb_3$ is significantly enhanced in the high temperature region due to significant enhancement of the electrical conductivity and absolute value of thermopower. The thermal conductivity of $Co_{0.76}Ni_{0.14}Fe_{0.10}Sb_3$ decreases with temperature down to 1.02 $Wm^{-1}K^{-1}$ at 600 K. As a result, the largest zT of 0.68 is attained for $Co_{0.76}Ni_{0.14}Fe_{0.10}Sb_3$ at 600 K. We also analyze the lattice thermal conductivity to gain insight into the contribution of various scattering processes that suppress the heat transfer through the phonons in $Co_{1-x-y}Ni_xFe_ySb_3$.

Biography

Chia-Jyi Liu is currently a Distinguished Professor at National Changhua University of Education, Taiwan. He received BSc from National Taiwan University in 1984. He received PhD from Johns Hopkins University in 1991 under the supervision of Prof. Dwain O Cowan who discovered the first organic metal TTF-TCNQ. He worked as a Post-doctor at the Johns Hopkins University, Southern Illinois University at Carbondale (1991-1992), as a Visiting Scientist at Superconducting Research Laboratory, International Superconductivity Technology Center, Japan (1992-1994), as a Research Fellow at Victoria University of Wellington, New Zealand (1995-1996) and as a Researcher at Industrial Research Limited, New Zealand (1996). His current interest is now developing novel materials for thermoelectrics.

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