Anisotropic Bi-Sb-Te Thermoelectric Nanomaterials: Synthesis, Characterization and Growth Mechanism

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Recently thermoelectric (TE) materials are becoming a very attractive field of research toward applications in micro cooling devices, energy conversion and waste heat recovery. For this purpose, these materials should have high thermoelectric figure of merit arising from high Seebeck coefficient, high electrical conductivity and low thermal conductivity. From bulk materials, it is challenging to achieve a high value for TE efficiency because of the close inverse relation between electrical and thermal conductivity. On the other hand, low dimensional materials offer a host of advantages to address this challenge based on electron transmission and phonon blocking at the particle grain boundary which helps maintain the electrical conductivity while reducing the thermal conductivity or the increase of the Seebeck coefficient due to the quantum confinement effect or energy filtering. Therefore, TE research now focuses on nano-structured materials. Especially, BiSbTe nanoparticles are expected to give one of the highest TE efficiencies.

Utilizing polyol method, our research group successfully synthesized BiSbTe nanoparticles with nanowire, nanodics, nano sheets or nanoflake morphology. We found that tuning the capping ligands, synthetic parameters together with combining metal precursors we can direct the size, shape, composition and structure of the resulting materials. Moreover, these results gave us an insight into some important aspects contributed to their growth mechanism such as precursor-ligand interaction, metal-metal interaction and combination effect of reactants. Wide range of characterization method were used to analyze the synthesized nanomaterials including TEM, XRD, TEM-EDS and ICP-MS,.,

Key words: anisotropic thermoelectric nanomaterials, polyol method