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MESOPOROUS MATERIAL PROCESSING AND APPLICATION

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ABSTRACT

Mesoporous ceramic materials have a structure containing nano-sized pores of 2~50 nm. Their pore size, pore distribution (regular/irregular, open/close), and pore shape can be controlled easily during sol-gel procedure using evaporation induced self assembly (EISA). During the EISA process, the pore structure of the films including porosity, pore size, and pore distribution can be controlled by varying the surfactant molar ratio. The existence of pores in the material grants distinctive properties such as decreased dielectric constant from increased porosity and decreased thermal conductivity from increasing phonon scattering. Therefore the mesoporous ceramic thin films can be used in many applications such as thermal insulators, low dielectrics, thermoelectrics, gas sensors, and so on.

Mesoporous titania and manganese-based films were prepared and their thermoelectric properties were investigated. The efficiency of a thermoelectric is determined by its dimensionless figure of merit, $Z = S^2\sigma/\kappa$ where S, σ, and κ are the Seebeck coefficient, electrical conductivity, and thermal conductivity, respectively. Various experimental approaches including a control of pore structure and introductions of dopants and nano-materials to enhance the thermoelectric property are discussed. Through the approaches, an individual control of governing parameters was carried out to control the thermal conductivity and electrical conductivity of mesoporous oxides to maximize the thermoelectric property.

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