

Development of novel thermoelectric materials by reduction of lattice thermal conductivity

REVIEW ARTICLE

Author Chunlei Wan^{1,2}, Yifeng Wang^{1,2}, Ning Wang¹, Wataru Norimatsu^{2,3}, Michiko Kusunoki^{2,3} and Kunihito Koumoto^{1,2}

Affiliations ¹ Graduate School of Engineering, Nagoya University, Nagoya, Japan
² CREST, Japan Science and Technology Agency, Kawaguchi, Japan
³ EcoTopia Science Institute, Nagoya University, Nagoya, Japan

E-mail koumoto@apchem.nagoya-u.ac.jp chunlei.wan@gmail.com

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TOPICAL REVIEW

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Abstract Thermal conductivity is one of the key parameters in the figure of merit of thermoelectric materials. Over the past decade, most progress in thermoelectric materials has been made by reducing their thermal conductivity while preserving their electrical properties. The phonon scattering mechanisms involved in these strategies are reviewed here and divided into three groups, including (i) disorder or distortion of unit cells, (ii) resonant scattering by localized rattling atoms and (iii) interface scattering. In addition, we propose construction of a 'natural superlattice' in thermoelectric materials by intercalating an *MX* layer into the van der Waals gap of a layered *TX*₂ structure which has a general formula of (*MX*)_{1+x}(*TX*)₂*n* (*M*=Pb, Bi, Sn, Sb or a rare earth element; *T*=Ti, V, Cr, Nb or Ta; *X*=S or Se and *n*=1, 2, 3). We demonstrate that one of the intercalation compounds (SnS)_{1.2}(TiS₂)₂ has better thermoelectric properties compared with pure TiS₂ in the direction parallel to the layers, as the electron mobility is maintained while the phonon transport is significantly suppressed owing to the reduction in the transverse phonon velocities.

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