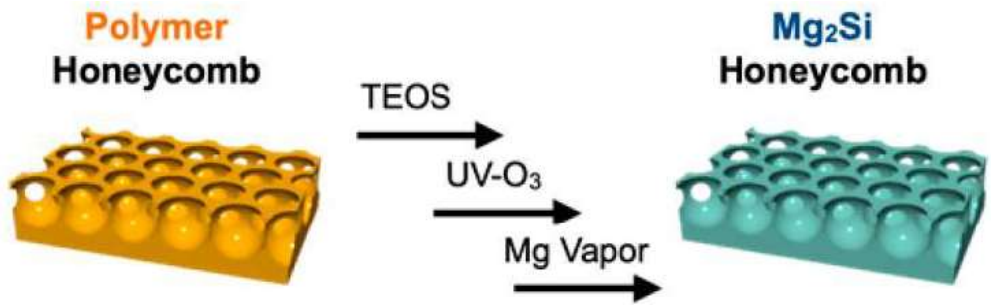
Tohoku Univ. Technology

Mg_2Si thermoelectric conversion film with reduced thermal conductivity while keeping electrical conductivity



Reference [1]

Mg_2Si film with high porosity and uniform vacancies

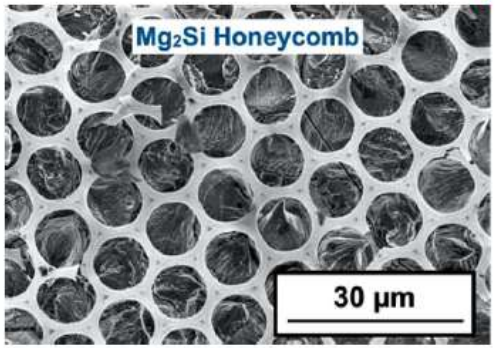
Overview

The development of thermoelectric conversion technology to extract electricity from waste heat is being actively pursued. Mg_2Si is a thermoelectric conversion material suitable for the use of industrial waste heat since the thermoelectric conversion efficiency achieves its maximum value at around 300ºC environment.

However, the heat is often leaked due to its high thermal conductivity so the conversion efficiency is not as high as expected (cf. right formula). There is a report that the thermal conductivity was decreased by compacting Mg_2Si powder into pellet and making it porous, but since the electrical conductivity was also reduced due the grain boundary, the conversion efficiency was not increased.

This invention is about a Mg_2Si porous film that solves the above issue.

Low thermal conductivity by honeycomb-like highly porous film



Reference [1]

$$ZT = \frac{S^2\sigma}{\kappa}T$$

ZT: figure of merit (*T*: Temperature)
S: Seebeck coefficient
σ: electrical conductivity
κ: thermal conductivity

Since the Seebeck coefficient is almost constant regardless of the material form, the larger the electrical conductivity and the smaller the thermal conductivity, the energy conversion efficiency index *ZT* becomes important.

Product Application

The present porous Mg_2Si film shows the same electrical conductivity (~2 S/cm) as an ordinary Mg_2Si thin film such as sputtered film, but the thermal conductivity is reduced by 11% even with a single porous structure layer. Therefore, it is possible to realize a thermoelectric conversion device by increasing film layers with less thermal leakage in the waste heat range around 300ºC.

Related Works

[1] *Chem. Mater.* 2020, 32, 10176.

IP Data

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