NU Tech
Technology Partnership of Nagoya University, Inc.

(E19)

Ta4SiTe4: Novel High-Performance Thermoelectric Material for Low Temp Applications

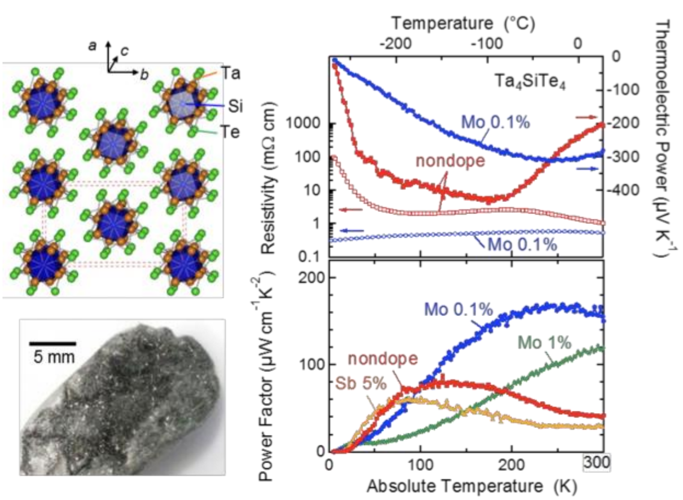
Background:

Thermoelectric cooling is a solid-state refrigeration process where the heat in an electrically conductive material is transferred using the material's own conduction electrons without any need for the gaseous coolants, such as chlorofluorocarbons. Since the coolers based on thermoelectric technology can be scaled down in size without changing energy conversion efficiency, a wide range of applications of them are highly expected. However, there is currently no bulk material with a high thermoelectric efficiency to reach a practical level in the low temperature region below -50°C.

Technology Overview:

Nagoya University researchers have successfully developed the highly effective compounds for truly low temperature applications as a High-Performance Thermoelectric Material. Material composed of a compound of tantalum, silicon and tellurium produced very high thermoelectric powers over a wide temperature range, from the cryogenic level of 50 K (which is around −223°C) up to room temperature, but still maintained the low electrical resistivity that is needed for practical cooling applications. These materials represent a realistic way to develop a high-performance thermoelectric cooling solution at very low temperatures.

Figure:



Ta4SiTe4 whisker crystals (left lower) show very large thermoelectric power exceeding -400 μV K-1 at low temperature, while maintaining low electrical resistivity (right upper). This results in that thermoelectric power factor (right lower), an indication of cooling power, becomes a very large value far exceeding those of the practical materials (typically 40 μW cm-1 K-2 for the Bi2Te3-based material). The optimum temperature of the power factor can be widely controlled by molybdenum (Mo) or antimony (Sb) doping.

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Further Details:

Yoshihiko Okamoto et al., Large thermoelectric power factor in one-dimensional telluride Nb4SiTe4 and substituted compounds. April 2018. Appl. Phys. Lett. 112, 173905

Takumi Inohara et al., Large thermoelectric power factor at low temperatures in one-dimensional telluride Ta4SiTe4. May 2017. Appl. Phys. Lett. 110, 183901

Applications: Ta4SiTe4, High performance between -230 oC and room temp. Much higher thermoelectric power factor than present materials

IP Status: Patent application submitted

Seeking: Licensing

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