Energy and environment

Thermoelectric waste heat recovery by environmentally benign materials

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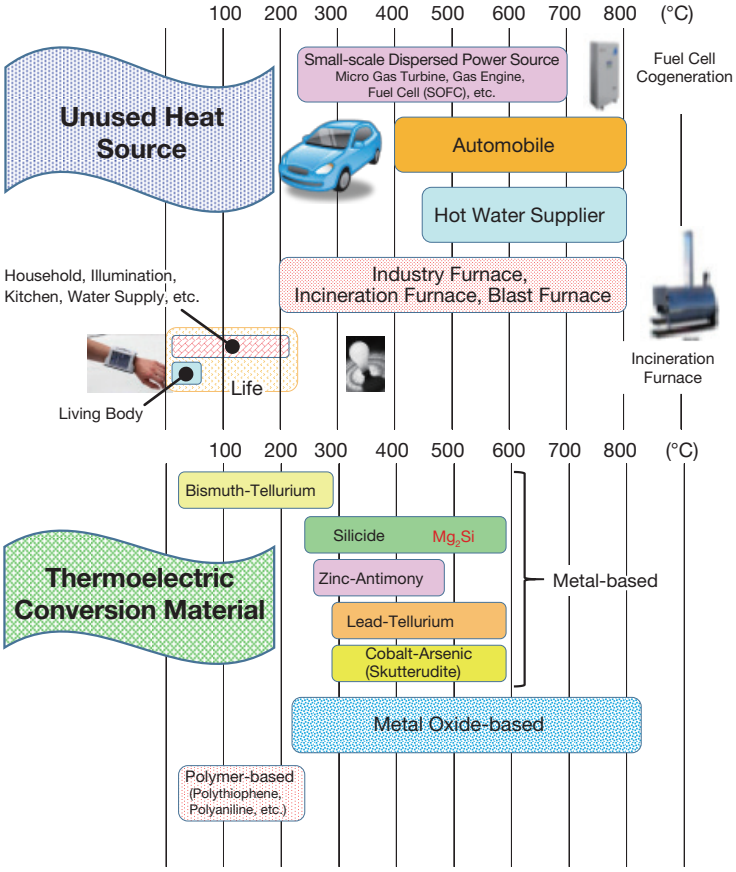
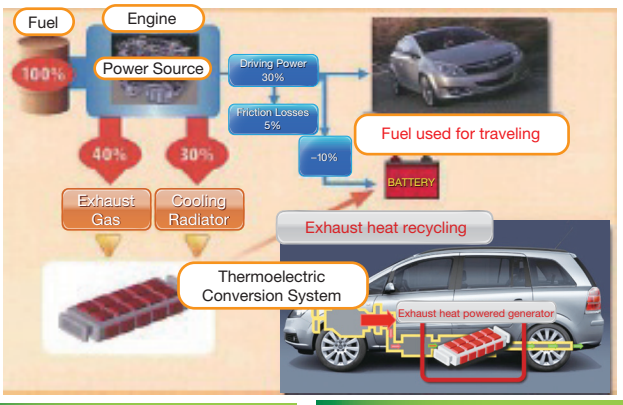
Purpose of Research

Waste heat is one of the important energy sources. Establishing thermoelectric conversion technology that generates highly useful electric energy from waste heat is important to develop the elemental technology essential for reducing carbon dioxide by improving energy utilization efficiency. The researchers have focused on molecular architecture, crystal structure, electronic property, etc. of the material, controlled semiconductor characteristics exhibition, electrical conductivity and heat conductivity, in order to implement high-performance thermoelectric conversion material, and searched proper material satisfying the conditions considering availability and safety as the raw material while securing high performance. Moreover, the researchers promote industry-academia-government cooperation at home and abroad, and work on development of power generation system, i.e. module which can efficiently utilize exhaust heat from automobiles or industry furnaces, and natural heat such as solar heat, ground heat and bioheat.

Summary of Research



We have studied how to find, how to improve, and how to utilize various thermoelectric conversion materials, including but not limited to inorganic, silicide, organic materials. The power generation module for automobile has been developed using magnesium silicide (Mg_2Si) among such materials, via industry-academia-government cooperation at home and abroad.



Points

- Research on thermoelectric conversion materials corresponding to heat sources in various temperature regions
- Good for the ecology and resources

Expected Applications

Fuel consumption is improved and CO_2 emission is reduced by converting exhaust heat from the automobile to electricity and recollecting it as the energy. This technology is expected to utilize the exhaust heat from the industry furnace or the incineration furnace, as well as from the automobile.

Comparison with Conventional or Competitive Technology

The conventional thermoelectric conversion material typically includes scarce or toxic elements, but this new material uses easily-available and safe elements only. The future subject is to realize recycling the exhaust heat from the automobile.

Challenges in Implementation

- Further improve thermoelectric conversion characteristics
- Evaluate and improve mechanical properties, durability and service life
- Evaluate and improve economic efficiency

What We Expect from Companies

We are finding a partner who is willing to develop the materials usable in the various fields.

Future Developments

We have studied various materials; especially regarding Mg_2Si, we carry out the performance improvement and preparation of a module prototype.

For corresponding to CARS 2020 Action Plan, we promote the development through industry-academia-government cooperation.

■ Associated Institution: Unused Heat Energy Conversion Division of GUAS
■ Intellectual Property: Japanese Patent Application No. 2012-517173 "Method for Manufacturing Thermoelectric Conversion Module and Thermoelectric Conversion Module" (filing several applications associated to organic and inorganic thermoelectric conversion material and modules at home and abroad)