Thermoelectric Oxide Materials

Thermoelectric technology is the energy conversion technique which produces electricity directly from solid semiconductor element caused by temperature difference. Because structure, construction system is so simple, thermoelectric technology has advantage over other kind of electricity production system. For example, they can be small and light, no exhaust emission, robust etc…At the moment, energy to electricity energy conversion efficiency is still low and they have been applied as some specific purpose as practical use. Recently, some other expectation to be applied as small scale energy conversion system by producing energy from waste heat in various places such as automotive exhaust gas and garbage incineration plants.

Efficiency of thermoelectricity is defined by electricity conductivity "σ" (determines resistance, conductivity of internal element), seebeck coefficient "S "(determines produced voltage per certain degree of temperature difference) and thermal conductivity "κ". Energy conversion efficiency is higher when no dimensional characteristic index "$ZT = S^2\sigma T/\kappa$" is higher. T is the average of operating temperature so that material which can be operated at higher temperature, can obtain higher efficiency. Practical industrial use can be accelerated when *ZT* exceeds 1.

So far, thermoelectric materials have been focused on mainly metal materials such as Bi_2Te_3 and PbTe etc… However, these chemical compounds include heavy element such as Bi, Pb and Te etc… and these materials can be toxic to the environment when they are evaporated or decomposed. In addition, economical cost of material, manufacturing process, recycling system could be an serious issue when one considers for industrial use.

In contrast, we have been focusing on metal oxide thermoelectric materials. Oxides are ceramic materials that have been used in human history for a long time and they are generally stable even at high temperature, has low toxicity, low material cost and manufacturing process has been established. These facts can be large advantage when one considers practical industrial application. Especially, oxide materials are more stable and superior when temperature is high over 800 °C.

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GS TECHNICAL INFORMATION

N type : $LaNiO_3$, $CaMnO_3$ ($Ca(Bi \cdot Gd)MnO_3$), Al doped ZnO

P type : $NaCoO_2$, $Ca_3Co_2O_6$, $Ca_3Co_4O_9$, $[Ca_2CoO_3]_{0.62}$

$[CoO_2]$, $NaCo_2O_4$ etc…

Especially we have improved $Ca_3Co_4O_9$ in our company and its seebeck coefficient exceeds over 100 - 200 μV/K. and we will keep improve to obtain even higher seebeck coefficient. We will also synthesize oxides thermoelectric materials as customer request besides above materials. Please consult with us anytime including technical detail.

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