

# Polycrystalline Heusler alloy thin film

Polycrystalline Heusler alloy film exhibiting performance comparable to that for a single crystal, which can be formed on a flexible substrate

## Overview

Co-based Heusler alloy such as  $\text{Co}_2\text{MnGa}$  or  $\text{Co}_2\text{MnAl}$  has attracted attention as candidate materials for high-sensitivity sensor and high-efficiency thermoelectric conversion element thanks to their large anomalous Nernst and Hall effects. In order to realize these excellent properties, it is thought that a single crystalline bulk material or a thin film grown on a single crystalline substrate is necessary. Thus, such single crystalline samples have been produced. Considering that those materials are applied to actual devices, it is necessary that a polycrystalline film, which does not use a single crystalline substrate, shows the property equivalent to those of single crystalline material.

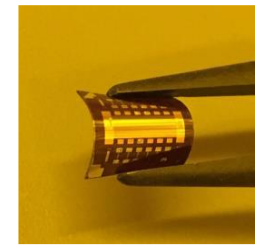
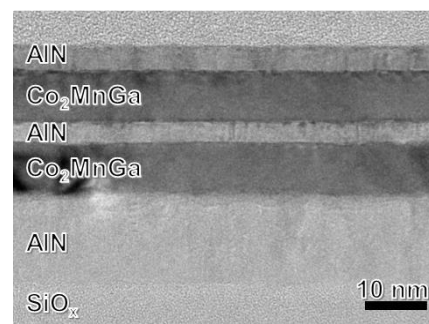
This invention is able to provide a "polycrystalline Heusler alloy thin film" that does not require a single crystalline substrate, while showing the properties of anomalous Hall angle ( $\theta_{\text{AH}} \sim 7.5\%$ ) and anomalous Nernst coefficient ( $S_{\text{ANE}} \sim 5 \mu\text{V}/\text{K}$ ) comparable to a single crystalline thin film. It can promote the control of crystal orientation and the improvement of crystallinity by sandwiching the polycrystalline layer with an insulating AlN layer.

## Product Application

- Thermoelectric conversion element that enables power generation from pipe drainage and indoor/outdoor temperatures
- Power generation by temperature difference between indoor and outdoor temperatures (temperature gradient)
- Realization of high-sensitivity sensor such as Hall sensor on a flexible substrate

## IP Data

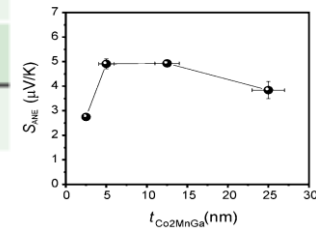
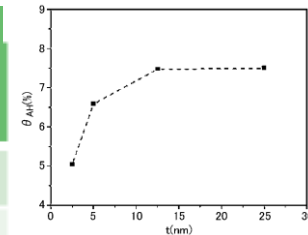
IP No. : JP2022-129848, WO2022/181642A1, TW111106123  
 Inventor : WANG Jian, SEKI Takeshi, TAKANASHI Koki  
 Admin No. : T20-2968



↑ Example of realization on a flexible substrate ( $S_{\text{ANE}} \sim 4 \mu\text{V}/\text{K}$ )

## Achievement of single crystalline level of $\theta_{\text{AH}}$ and $S_{\text{ANE}}$ despite a polycrystalline film

Material	Sample type	Anomalous Hall angle $\theta_{\text{AH}}$ (%)	Anomalous Nernst coefficient $S_{\text{ANE}}$ (mV/K)
$\text{Co}_2\text{MnGa}$	Bulk single crystal	> 10	6
$\text{Co}_2\text{MnGa}$	Single crystalline thin film	$\sim 10$	6.2
$\text{Co}_2\text{MnGa}$	Single crystalline thin film	8.5	3
$\text{Co}_2\text{MnGa}$	Polycrystalline thin film	7.5	5



## Related Works

[1] Jian Wang, Yong-Chang Lau, Weinan Zhou, Takeshi Seki, Yuya Sakuraba, Takahide Kubota, Keita Ito, and Koki Takanashi "Strain-Induced Large Anomalous Nernst Effect in Polycrystalline  $\text{Co}_2\text{MnGa}/\text{AlN}$  Multilayers" Adv. Electron. Mater. 2101380-1-8 (2022).

## Contact

Download OnePager



Contact

<https://www.t-technoarch.co.jp/en/contact.html>



Check Out Our Inventions

<https://www.t-technoarch.co.jp/en/anken.php>



Follow us

<https://www.linkedin.com/company/tohoku-techno-arch>



# Leading you to Successful Industrialization



**TOHOKU TECHNO ARCH**

株式会社 東北テクノアーチ