# Fe 薄膜の Ga 置換による異常ネルンスト効果の増大と熱流センサ応用

## Strong enhancement of anomalous Nernst effect in Fe by Ga substitution and its application for heat flux sensor

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The anomalous Nernst effect (ANE) is representative magneto-thermoelectric phenomena in conductive ferromagnets. The ANE generates an electromotive force in the direction along the outer product of an applied temperature gradient and spontaneous magnetization in magnetic materials. Recently, the ANE has been studied in various materials to clarify its microscopic mechanism and to investigate its potential as thermoelectric generators and/or heat-current sensors [1-5]. Previous work demonstrates that the thermoelectric voltage through the ANE is dramatically enhanced by utilizing the simple lateral thermopile structures [1]. Furthermore, it is possible to develop the flexible and wearable thermoelectric conversion devices by utilizing the ANE [2]. However, it is still necessary to explore the materials showing larger efficiency of thermoelectric conversion.

Recently, the large ANE was reported in polycrystalline galfenol (Fe-Ga) [4]. Interestingly, it shows large thermopower of ANE (~ 3μV/K) in simple binary alloy systems although the values in single-crystalline bulk Fe is about -0.1 μV/K [3]. However, the previous work focused on the polycrystalline galfenol and its Ga composition is fixed at $x$ = 0.15. Therefore, the underlying mechanism of the strong enhancement of the ANE from Fe to galfenol has not been clarified at all. In order to explore the materials showing larger ANE, it is necessary to clarify the origin of the enhancement of ANE in Fe by Ga substitution. In this study, we investigate the ANE in epitaxial Fe-Ga thin films with different Ga compositions.

The systematic thermoelectric and magnetotransport measurements including the Seebeck effect and anomalous Hall effect measurements revealed that the large ANE in $Fe_{1-x}Ga_x$ is mainly attributed to the large transverse Peltier coefficient, which agrees with the prediction based on the first-principles calculations [5]. In this presentation, I will also show the ANE-driven heat flux sensor with Fe-Ga films.

**References**

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