Topologically enhanced anomalous Nernst effect in $Fe_3Ga_{1-x}Al_x$ and $Fe_3Al_{1-x}Si_x$

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Anomalous Nernst effect (ANE) is the generation of a transverse voltage perpendicular to both the magnetization and the heat current in ferromagnets, which gains increasing interest due to its various potential benefits[1]. Recently, iron-based binary alloy Fe_3Ga and Fe_3Al were discovered with record-large anomalous Nernst value[2]. This system will provide an excellent research platform to explore the topological origin of such a large ANE.

We have systematically synthesized polycrystalline $Fe_3Ga_{1-x}Al_x$ and $Fe_3Al_{1-x}Si_x$ with different doping levels (x=0, 0.25, 0.5, 0.75, 1) and studied the dependence of the magnetic and transport properties, specially anomalous Hall and Nernst effect on chemical doping. We found the giant Nernst signal remains sizable even in polycrystalline samples, which declares that arc-melting polycrystals can also provide essential information in material screening procedures. Moreover, a systematic and nearly linear change of the ANE was observed as a function of chemical doping, indicating the intrinsic contribution to the ANE is dominant and is robust against chemical disorder, which is a defining characteristic of topological states.

[Reference]

[1] Mizuguchi, M,et al. Science and technology of advanced materials, 2019, 20 (1): 262-275.

[2] Sakai, A, et al. Nature, 2020, 581: 53–57