Anisotropic Magnetotransport Properties of Magnetic Shape Memory Heusler Alloy $Ni_{50}Mn_{25}Ga_{20}Fe_5$

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Heusler alloys of Ni_2MnGa, and its off-stoichimetry or substituted derivatives, show multiferroic properties including the magnetic shape memory effect (MSM) [1-2]. This property has received significant attention due to its application potential in micropumps, actuators, and sensors [3]. The magneto-crystalline anisotropy of the martensite states is a key requirement allowing magnetic-field induced reorientation (MIR) of twin domains that defines the magnetic shape memory effect.

Magnetotransport properties of Ni_2MnGa has gained far less attention than its magnetoelastic investigation. Difficulties in maintaining a single variant state, as well as complications in maintain electrical contacts during the up to 12 % magnetic-field induced strains has hindered electrical transport investigations. Here we will present results of extensive magnetotransport measurements (resistivity, magnetoresistance, and Hall effect) of single crystalline $Ni_{50}Mn_{25}Ga_{20}Fe_5$. The material undergoes martensitic transformation into the 10M MIR-active phase on cooling below $T_{mart} = 309$ K, as well as further inter-martensitic transformations into the 14M and non-modulated (NM) phases on further cooling.

To maintain a single-variant state in 10M martensite, a custom-built in-situ compression device was used. Despite maintaining a unique short-axis, the inter-martensitic transformations to 14M and NM phases inevitably result in multi-variant states. We will present both the device, and the results of the anisotropic magnetotransport measurements across these phase transitions in this intriguing multiferroic material.

References:

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