Localized-Itinerant Ferromagnetism of the Two-Dimensional Van der Waals Metallic Fe5-xGeTe2 Single Crystal

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Two-dimensional van der Waals ferromagnet Fe5-xGeTe2 material has drawn increasing attention due to its near-room Curie temperature (Tc) and wide spectrum of physical characteristics. However, the magnetism of quenched Fe5-xGeTe2 single crystals has been found to be complex due to its dependency on thermal history. On the other hand, very few studies on electrical transport properties have been conducted. Here, we report the thermal history-dependent physical properties of a quenched Fe5-xGeTe2 single crystal with x = 0.16 by employing the temperature-dependent magnetization, isotherm magnetization, electrical resistivity, Seebeck coefficient, thermal conductivity, and specific heat measurements. The results represent the local ferromagnetic moment at Curie temperature, Tc = 310 K, and the helimagnetic phase transition, Th = 273 K. Our observations shed new light on the origin of and interplay between the thermal history-dependent magnetic and electrical properties of van der Waals ferromagnets.