Thermodynamic and magnetotransport properties of single-crystalline half-Heusler antimonides RPtSb (R = Gd, Tb, Dy and Ho)

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High-quality single crystals of the half-Heusler compounds RPtSb (R = Gd, Tb, Dy, Ho) were grown for the first time using the flux method. Their thermodynamic properties (magnetic susceptibility, magnetization, heat capacity) and electrical transport characteristics (resistivity, magnetoresistance, Hall effect) were thoroughly investigated over wide ranges of temperature and magnetic field. At low temperatures, these antimonides order antiferromagnetically, with Néel temperatures decreasing systematically from Gd to Ho. The compounds exhibit semimetallic behavior, characterized by distinct humps in the temperature dependence of the electrical resistivity. In weak magnetic fields and at low temperatures, a positive magnetoresistance is observed, indicating a weak antilocalization effect driven by strong spin-orbit coupling. In turn, the high-field magnetoresistance is dominated by negative contribution, which can be attributed to the de Gennes–Friedel mechanism. The Hall resistivity data demonstrate the multiband nature of the electrical transport, with holes being the majority charge carriers. The field-angle dependent magnetoresistance features higher-order symmetry terms, whose contributions evolve systematically with temperature and magnetic field strength. These results suggest that the electrical transport in the RPtSb compounds is governed mostly by small Fermi surface pockets, and that external factors such as magnetic field and temperature can easily induce a reconstruction of their electronic band structure.

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