Parallel resistor induced by the spin-state crossover in the Sr-Co-O system

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It is now becoming more generally recognized that strongly correlated electron systems may owe their drastic physical phenomena to a phase separation or dynamic phase segregation. The intrinsic inhomogeneous effects on physical properties observed for several cobalt oxides have not been fully understood. It also remains elusive whether a straight or parallel response to the external fields such as electric field and temperature gradient is effective for fulfilling a better condition as thermoelectric materials. This situation is partially due to a lack of actual observations of the latter response. This study, therefore, is motivated by the desire to explore a new material in which both the phase separation and parallel response occur.

In this study, we report the synthesis of the Sr-Co-O single crystal, and its transport and magnetic properties. In contrast to the typical metallic or semiconducting conductivity, the in-plane electrical resistivity below 80 K is almost independent of temperature. Taking the data derived from several experimental probes into consideration, this peculiar behavior is attributable to the coexistence of the metallic and semiconducting phase probably caused by the spin-state crossover below 150 K, rather than a zero gap by the massless Dirac particles; carriers in both the phases are associated with the electrical conduction.