Title:	Study of the Superconducting Properties of Some rare-Earth and Transition Metal Borides with Quasi-low-dimensional Crystal Structures
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Abstract:	i Abstract The phenomenon of superconductivity has been studied intensively not only for the fundamental physics involved but also for the promise of technological applications. The transition from the normal to the superconducting phase is accompanied by remarkable changes in measurable properties like electric transport, magnetization, and heat capacity, among others. Measurements of these properties provide a powerful tool to address the nature of superconductivity. Superconductors with anomalous properties, which are dif- ferent from conventional superconductors, are always interesting to study and challenging to understand. Multigap superconductivity is an example of this kind. In multigap super- conductors, energy gaps of different magnitudes exist on different, disconnected parts of the Fermi surface, giving rise to non-BCS observations of various physical properties. Following the report of high T_c superconductivity in MgB_2 and subsequent discovery of its multigap nature, there has been increased interest in investigating metal borides with similar structures. MgB_2 has a layered crystal structure that is composed of flat graphite- like sheets of boron atoms separated by hexagonal close packing layers of transition metal atoms. These sheets of Boron atoms are considered to be crucial in giving MgB_2 its novel properties. This thesis presents our investigations on the superconducting properties of polycrys- talline samples of TB_2 (T = Ru, Os) and $RRuB_2$ (R = Y, Lu). These materials have several ingredients which make them a candidate for novel superconductivity. The tran- sition metal elements provide the possibilities of multiple orbitals, which can make up a Fermi surface with many sheets. The light mass of Boron could provide for a high T_c . Additionally, these materials have layered or quasi-low-dimensional structure mo- tifs. OsB_2 , which crystallizes in an orthorhombic structure (Pmmn) containing deformed Boron sheets instead of a flat Boron array as in MgB_2 , has previously been reported to exhibit multigap superconductivity and RuB_2 is isoelectronic and isostructural to OsB_2 . (Y, Lu)RuB_2 compounds crystallize in an orthorhombic structure (space group Pnma), having a zigzag chain of rare-earth atoms, with dimerized Boron and have been reported to exhibit a relatively large value of superconducting temperature. Magnetization, resis- tivity, and heat capacity measurements were performed on the polycrystalline samples of RuB_2 . The temperature dependence of heat capacity in the superconducting state, a reduced heat capacity anomaly at superconducting transition, and the value of Ginzberg- Landau parameters indicate that RuB_2 is a rare two gap type-I superconductor. Theo- retical calculations of band structure and the Fermi surface for RuB_2 also support the possibility of multigap superconductivity. Various measurements on $RRuB_2$ (R = Y, Lu) and estimation of the various superconducting parameter has been carried out. The mag- netic field-temperature (H-T) phase diagram shows an anomalous linear trend, pointingii to possible unconventional superconductivity. In $LuRuB_2$, the $\Delta(T)$ dependence which deviates from BCS predictions and the small $\Delta/k_B T_c$ value also suggest unconventional superconductivity, supporting conclusions from the H-T phase diagram. On the other hand, T_c of both OsB_2 and $LuRuB_2$ reduces with the application of pressure, supporting an electron-phonon mediated superconductivity in both these families of compounds.
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