

CRYSTAL STRUCTURE AND MAGNETIC PROPERTIES OF**Pr_{1-x}Tb_xMn₂Ge₂**

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Temperature and field dependence of the magnetic behavior of magnetic moments of the rare earth and Mn sublattices of RMn₂Ge₂, where R is a rare earth element, leads to a variety of interesting magnetic properties. These compounds crystallise in the tetragonal ThCr₂Si₂ type crystal structure with space group *I4/mmm* which consist of layers along the c-axis with sequence R-Ge-Mn-Ge-R. When light rare-earth elements (Pr, La, Ce or Nd) use in title compounds, the interlayer magnetic coupling in the Mn sublattice is ferromagnetic, whereas it is antiferromagnetic in the case of Gd, Tb or Dy. At low temperatures, the rare earth sublattice also orders and reconfigures the ordering in the Mn sublattice. In this study, crystal structure and magnetic properties of Pr_{1-x}Tb_xMn₂Ge₂ compounds were investigated by X-ray diffraction and magnetic measurements. The results of earlier neutron diffraction and Mössbauer studies on samples with x = 0 and x = 1 are also used for interpreting the magnetization data and to give an account on the competing effects between various magnetic structures in the Mn and rare earth sublattices. In low field, we have observed that, temperature dependence of zero field cooled and field cooled magnetizations shows large difference at the Curie temperature of Mn sublattices (T_C). This behavior is related to pinning of the ferromagnetic components of Mn sublattices and proved that there is an antiferromagnetic ordering of Mn sublattices with Neel temperature T_N > T_C, which has been observed only by using neutron diffraction techniques.

Keywords: LAYERED MAGNETIC STRUCTURE, RARE EARTH MAGNETISM, PINNING

CRYSTAL STRUCTURE AND SUPERCONDUCTING PROPERTIES**OF Sr₂YCu₂(Fe,Co)O_{6+δ}**

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Crystal structure of Sr₂YCu₂FeO_{6+δ} and Sr₂YCu₂CoO_{6+δ} has been analyzed using neutron powder diffraction. These compounds consist of nanometer-scale sequence of alternating double CuO₂ sheets as those in high-T_c superconductors, and (Fe,Co)O₆ sheet similar to that in the Sr(Fe,Co)O_{3+δ} magnetic compound with brownmillerite-type structure. Sr₂YCu₂FeO_{6+δ} exhibits superconductivity around 50 K when it is annealed under N₂ atmosphere and subsequently under O₂ atmosphere, while Sr₂YCu₂CoO_{6+δ} with the same annealing process does not exhibit superconductivity. Neutron diffraction study indicates that it is easy to substitute Cu for Fe in Sr₂YCu₂FeO_{6+δ} and the N₂-annealing suppresses this substitution, while Cu is hardly substituted for Co in Sr₂YCu₂CoO_{6+δ}. The annealing process is very effective on the control of oxygen content, 6+δ, in Sr₂YCu₂FeO_{6+δ}, although the δ value do not deviate substantially from unity by the annealing process in Sr₂YCu₂CoO_{6+δ}. These results show that enough amount of oxygen cannot be supplied onto the CoO₆ sheet to exhibit superconductivity in Sr₂YCu₂CoO_{6+δ}.

Keywords: HIGH-TC SUPERCONDUCTOR, NEUTRON DIFFRACTION, 1212 PHASE

X-RAY POWDER DIFFRACTION STUDY AND OPTICAL CHARACTERIZATION OF THE Cu(In_{1-x}Ga_x)₃Te₅ SEMICONDUCTING SYSTEM

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Ingots of several compositions of the Cu(In_{1-x}Ga_x)₃Te₅ semiconducting system were prepared by the Bridgman technique in a multi-zone vertical furnace. X-ray powder diffraction and optical studies allowed to characterize the fundamental structural aspects and determine the energy band gap E_g of these materials. The structural study carried out using powder diffraction data collected with a SIEMENS D-5005 diffractometer indicates that a solid solution is formed over the entire range of composition. The parameters a and c of the tetragonal chalcopyrite-related unit cell obtained vary from 6.1639(3) and 12.346(2) Å for x = 0 to 5.9321(8) Å and 11.825(4) Å for x = 1, respectively. The variation of the energy band gap with composition is linear, contrary to the quadratic relation of the form E_g = a + bx + cx² observed in the Cu(In_{1-x}Ga_x)₃Se₅ semiconducting system.

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Keywords: SEMICONDUCTORS POWDER DIFFRACTION BAND GAP

RAPID HTXRD ANALYSIS OF PHASE EVOLUTION IN CERAMIC MATERIALS

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Inorganic chemical reactions responsible for the development of the microstructure and phases of technologically significant ceramic materials have been investigated with the use of rapid high-temperature x-ray diffraction. To assist in the dynamic *in situ* study of materials processes involving volatile agents, X-ray transparent reaction vessels have been developed. These chemically inert and hermetically sealed cells serve to uniformly heat the sample and its enclosed environment while minimizing the loss of aggressive vapor species from the cells. Currently these cells are being employed in the previously impossible studies of applications such as the reduction of oxide ceramic precursors by reactive alloy liquids and phase evolution in thallium-based cuprates. The investigation of such processes has been greatly enhanced by the use of a two-dimensional GADDS X-ray detector system, which enables the simultaneous analysis of texture and phase identification. Results of the 2D texture analysis of HTSC thin film materials prepared by Inclined Substrate Deposition and melt-texturing as well as phase evolution in several ceramic systems are presented.

Keywords: POWDER DIFFRACTION, HIGH TEMPERATURE DIFFRACTION, IN SITU DIFFRACTION