

Phase transition studies of paramagnetic crystals at low temperatures

S K DUTTA ROY and B GHOSH*

Department of Physics, Indian Institute of Technology, Kharagpur 721 302, India

*Saha Institute of Nuclear Physics, 92, Acharya Prafulla Chandra Road, Calcutta 700 009, India

Abstract. Magnetic, thermal, electrical and optical properties of a series of paramagnetic compounds of general formula $ABF_6 \cdot 6H_2O/6D_2O$ and $A(ClO_4)_2 \cdot 6H_2O$ where $A = Co, Na, Zn, Hg$ and $B = Si, Ti, Zr$, showing structural transition from room temperature hexagonal with one molecule in the unit cell to low temperature monoclinic with two molecules in the unit cell, are reviewed.

Keywords. Phase transition; paramagnetic crystals; low temperatures.

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1. Introduction

The beginning of the phase transition study of paramagnetic crystals was in 1956 when a number of experiments were performed at the Indian Association for the Cultivation of Science on the magnetic susceptibility of a series of double sulphate and double selenate chromic alums. The anomalous magnetic susceptibility behaviour observed in these alums in the temperature region 180 to 220 K was confirmed by Mitra *et al* (1964). However, the most important experiment in phase transition study of paramagnetic crystals was by Datta and Mazumdar (1965) who observed from magnetic anisotropy measurements in the temperature region 90-300 K, that the magnetic symmetry in $CoSiF_6 \cdot 6H_2O$ single crystals undergoes a transition at $T_c \sim 246$ K from uniaxial to orthorhombic. Dutta Roy and Ghosh (1968) obtained similar results in $CoF_2 \cdot 5HF \cdot 6H_2O$ and $CoZrF_6 \cdot 6H_2O$. It was also shown that the magnetic anisotropy anomaly observed in fluosilicates, hydrofluorides, and fluozirconates were due to a structural transition from room temperature hexagonal to low temperature monoclinic structure (Dutta Roy *et al* 1971). Chowdhury and Ghosh (1974) included a number of perchlorates in the series of paramagnetic crystals showing phase transition. Further evidences were given by Ghosh *et al* (1979), in deuterated fluosilicate and fluotitanate crystals. It is well known that a series of paramagnetic crystals of general formula $ABF_6 \cdot 6H_2O/6D_2O$ and $A(ClO_4)_2 \cdot 6H_2O/6D_2O$ where $A = Co, Mn, Fe, Zn, Mg$, and $B = Si, Ti, Zr$ undergo phase transition in the temperature region 77-300 K. Recently thermal (Sinha *et al* 1976), optical (Choudhury *et al* 1983), and electrical properties (Ghosh *et al* 1979) of these compounds have also revealed anomalous characteristics, at their respective transition temperatures. It is, therefore, important to review at this stage all the important results observed in these compounds for a possible