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Magnetic Transformations in the $Mn_2Ge_ySb_{1-y}$ System in Strong Magnetic Fields under High Pressure

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At temperature changes some magnetic phase transformations are observed in the $Mn_2Ge_y Sb_{1-y}$ system, which are accompanied by magnetic structure changes. The main characteristics of such transformations, magnetization change, change of the entropy of the spin system, and transition heat, were determined on the basis of magnetic measurements over a wide range of magnetic fields. The effect of pressure on the magnetic transformation temperature was also studied. An analysis of the experimental results is made on the basis of Kittel's exchange inversion theory.

Bei Temperaturänderungen werden einige magnetische Phasentransformationen im System $Mn_2Ge_ySb_{1-y}$ beobachtet, die von magnetischen Strukturänderungen begleitet sind. Die Hauptcharakteristiken solcher Transformationen, Magnetisierungsänderungen, Änderungen der Entropie des Spinsystems und Übergangswärme, werden auf der Grundlage magnetischer Messungen in einem großen Magnetfeldbereich bestimmt. Der Einfluß von Druck auf die magnetische Transformationstemperatur wurde ebenfalls untersucht. Eine Analyse der experimentellen Ergebnisse wird auf der Grundlage der Kittelschen Austauschinversionstheorie durchgeführt.

1. Introduction

In the $Mn_2Ge_ySb_{1-y}$ system there were observed two phase transitions of the first kind, at which the lattice symmetry did not change. These are a transition from the ferrimagnetic structure (FM) to the spiral one (SP) and from the spiral to the antiferromagnetic structure (AF) [1]. Furthermore at nitrogen temperature one more magnetic transformation was observed which is connected with a lattice symmetry change [2]. As a result of this transformation the rigid collinearity of sublattice magnetizations is distorted and a transition into the weak ferromagnetic state (FMS) is observed. For the description of magnetic transformations associated with the exchange interaction inversion Kittel developed a thermodynamic theory, supposing that the molecular field constant α, presenting interlattice interaction, depends on temperature and hence on the lattice parameter C. Assuming a linear dependence of exchange interaction on lattice parameter, it is possible to write

$$E_{ex} = - \frac{\partial \alpha}{\partial C} (C - C_k) M_A M_B , \qquad (1)$$

where C_k is a lattice parameter corresponding to the exchange interaction inversion. It was expected than, that the magnetizations of sublattices M_A and M_B were equal and did not depend neither on C nor on temperature. Using such a form of the exchange energy in the expression for the thermodynamic potential, Kittel obtained relations connecting physical quantities which define