CHAPTER I

INTRODUCTION

Neutron spectrometer was first built at Argonne National Laboratory in the U.S.A. in 1945. Since then scientists have installed neutron spectrometers in research reactors around the world. In general the scattering of neutrons by atoms is a nuclear collision process, except for case of magnetic atoms, where there is additional scattering on account ofthe interaction between neutron's magnetic moment and the magnetic moment of the atom. Neutron diffraction technique has proved to be a powerful and fruitful technique in solid state physics research and it has made significant contributions to the study of atomic magnetism in solids. It is a unique method of directly ascertaining the magnetic phase or magnetic structure which is a direct manifestation of the magnetic interaction among the atoms in the solid. These investigations also yield valuable information on the transition point from one magnetic phase to another and on the magnetization behaviour of magnetic atoms in various atomic coordinations.

A double axis neutron spectrometer has been installed at Thai Research Reactor - 1 (TRR - 1) since 1967 for studying the magnetic structure of magnetic materials[(1)]. Other facilities such as liquid nitrogen cryostat, neutron polarization equipment, furnace for preparation of alloy samples, have been furnished for supporting research in this field. A furnace for elevated temperature experiments has been made for neutron diffraction studies at temperatures above room temperature. Several binary and ternary alloys have been prepared for neutron diffraction studies[2]. In particular, the ternary alloy $Ni_{1.55}Mn\ Ge_{0.45}$ is of great interest for the present investigation.

Ternary Laves phases in the system Mn-Ni-Ge had been studied by Yu. V. Kuz'ma et.al.[3] using X - ray diffraction technique. They studied ternary alloys containing 33.3 atomic percents manganese and different percentages of germanium and nickel. Of these alloys $Ni_{1.55}Mn\ Ge_{0.45}$ and $Ni_{1.3}\ Mn\ Ge_{0.7}$ are the only two existing ternary alloys which show single phase. They found that the X - ray diffraction pattern of powder $Ni_{1.55}\ Mn\ Ge_{0.45}$ could be explained by cubic Laves phase, $Mg\ Cu_2$ type structure with lattice constant $a = 6.762$ Å while the $Ni_{1.3}\ Mn\ Ge_{0.7}$ was found to be hexagonal Laves phase type, $Mg\ Zn_2$ type structure, with $a = 4.856$ Å, and $c = 7.635$ Å. Since neutron diffraction studies of these alloys have not yet been done, it is interesting to see what information can be obtained.

The purpose of this thesis is to study the magnetic structure and magnetic transition temperature of $Ni_{1.55}\ Mn\ Ge_{0.45}$ by the neutron diffraction technique. This was done by using powder sample with unpolarized neutrons. Magnetic structure can be determined from neutron diffraction pattern of this sample while magnetic transition temperature can be deduced by measuring the intensity of the magnetic peak at different temperatures.

The outline of this thesis is as follows:

In Chapter II, a review of neutron spectrometer and the basic theory of neutron diffraction will be given.

Chapter III is concerned with experimental technique and experiental results.

Chapter IV is devoted to a summary and discussion of the results obtained.