Shape memory refers to the ability of certain materials to "remember" a shape, even after rather severe deformations: once deformed at low temperatures (in their martensitic phase), these materials will stay deformed until heated, whereupon they will spontaneously return to their original pre-deformation shape.

The TiNi based shape memory material produced through rapid solidification has superior shape recovery and strength properties, improved corrosion resistance compared to that of conventionally processed alloys. Rapidly solidified TiNi based ribbons provide fine grained structures with minimum processing steps thereby reducing the cost. Moreover, these rapidly solidified ribbons have an edge over thin film deposition due to their controlled composition.

In practical polycrystalline materials, crystallographic textures accordingly influence shape memory effect, resulting in planar anisotropy of shape memory strain. Higher shape memory strains at certain directions can be made possible by developing the most favorable preferred orientations through texture control. It is very important to study the texture of the rapidly solidified ribbon specimens in order to obtain maximum transformation strain in the desired direction for microactuator applications.

The aim of the present study is to investigate the effect of third element addition on the texture on rapidly solidified TiNi based melt spun ribbons.
Chapter 1 provides an introduction about the shape memory effect, martensitic transformation, shape memory alloys, functional properties of shape memory alloys, TiNi binary alloys, R-phase transformation, ternary TiNi alloys, processing, texture and rapid solidification processing.

In Chapter 2, the experimental techniques such as differential scanning calorimetry (DSC), thermo mechanical analysis (TMA), chill block melt spinning process, determination of pole figure and orientation distribution function are explained in detail.

Chapter 3 deals with the study of properties and texture analysis of Ti$_{52}$Ni$_{38}$Cu$_{10}$ (at%) rapidly solidified melt spun ribbon specimens. The narrower hysteresis of Ti-Ni-Cu alloys has practical importance. Applications requiring a fast response time on thermal cycling are easier to realize with narrow hysteresis alloy. Moreover, it becomes difficult to prepare Ti-Ni-Cu SMAs with higher Cu content by conventional method due to their brittleness. Rapid solidification technique acts as a solution to this problem.

The bulk specimens were prepared with arc melting furnace on a water-cooled copper hearth under Ar atmosphere. The ribbon specimens were made through chill block melt spinning method. The chemical compositions of the bulk specimens were measured with EPMA. The transformation temperatures of the bulk and the ribbon specimens after heat treatment at 1073 K for 3.6 ks were measured through DSC. The microscopy studies were performed on the as-spun and heat treated specimens were carried out with the aid of TEM. From the XRD and TEM studies, it was observed that the Ti$_{52}$Ni$_{38}$Cu$_{10}$ melt spun ribbon specimens were found to be partially amorphous in the as-spun condition. After heat treatment at 1073 K for 3.6 ks followed by
water quenching, the specimens became crystalline. DSC measurement of the bulk and the melt spun ribbon specimens after heat treatment at 1073 K for 3.6 ks show that the transformation temperature of the rapidly solidified ribbon specimen decreases compared to that of the bulk specimen.

Texture analysis of the as-spun and heat treated melt spun ribbons were performed through pole figure measurement and crystallite orientation distribution function. It was observed that the specimens show strong \{200\} type texture. The transformation strain as a function of cut angle from the spun direction was calculated and it was found that the as-spun ribbon specimen shows higher transformation strain than that of heat treated ribbon specimen. Thermomechanical studies reveal that the shape the heat treated ribbon specimens show excellent shape recovery under different loading conditions.

In Chapter 4, the effect of texture in rapidly solidified ribbons by replacing Ni with small amounts of Fe in equiatomic TiNi is reported. Fe is often added to equiatomic TiNi alloys in order to suppress the martensitic transformation temperature while maintaining the stability and high ductility.

For this purpose, Ti$_{50}$Ni$_{50-x}$Fe$_x$ (at%) (x=1.0, 1.5, 2.0, 2.5, 3.0, 5.0) melt spun ribbons were prepared through chill block melt spinning process. Chemical composition of the bulk and ribbon specimens were measured with the aid of EPMA. Transformation temperatures of the bulk and ribbon specimens were measured with DSC. Texture measurement of the Ti$_{50}$Ni$_{50-x}$Fe$_x$ (at%) (x=1.0, 1.5, 2.0, 2.5, 3.0, 5.0) melt spun ribbon specimens were performed through the determination of pole figures and crystallite orientation distribution function. The results show that melt spun Ti$_{50}$Ni$_{49}$Fe$_1$, Ti$_{50}$Ni$_{48.5}$Fe$_{1.5}$ and Ti$_{50}$Ni$_{47.5}$Fe$_{2.5}$ ribbon specimens in as-spun condition and
after heat treatment at 1073 K show strong \{200\} type texture whereas other specimens show random texture. It was found that randomness in texture resulted due to the increase in the addition of Si during the rapid solidification process.

Chapter 5 deals with the effect of addition of small amounts of third element at the Ni site of equiatomic TiNi rapidly solidified melt spun ribbons. Addition of third elements opens even more possibilities for adopting binary TiNi alloys toward more specific needs of applications. Allo-ying third elements will influence not only the transformation temperatures but will also have an effect on hysteresis, strength, ductility, shape memory characteristics and on the transformation sequence.

$\text{Ti}_{50}\text{Ni}_{49}X_1 \ (\text{at\%}) \ (X=\text{Co, Cr, Cu, Mn, V})$ melt spun ribbon specimens were prepared. Chemical composition of the bulk and ribbon specimens were measured with EPMA. DSC measurements were carried out on bulk and ribbon specimens. Texture measurement of the $\text{Ti}_{50}\text{Ni}_{49}X_1 \ (\text{at\%}) \ (X=\text{Co, Cr, Cu, Mn, V})$ melt spun ribbon specimens were performed through the determination of pole figures and crystallite orientation distribution function. It was observed that $\text{Ti}_{50}\text{Ni}_{49}\text{Cr}_1$ ribbon specimens in as-spun and heat treated condition show strong \{200\} texture whereas $\text{Ti}_{50}\text{Ni}_{49}\text{V}_1$ show weak \{200\} texture. Other specimens show random texture due to the increased Si addition.

Chapter 6 provides the summary of the results obtained, conclusion and future work.