The work presented in the thesis entitled "*Study of glass forming ability and thermal stability of multicomponent amorphous alloys*" comprises theoretical as well as experimental study of metallic glass forming alloys. Theoretical investigations include study of thermodynamic aspects of metallic glasses, different GFA parameters and estimation of critical cooling rate (R_c) using Time-Temperature-Transformation (TTT). Experimental study includes the study crystallization kinetics of $Zr_{52}Cu_{18}Ni_{14}Al_{10}Ti_6$ metallic glass.

Theoretical studies include details about the prediction of glass forming ability (GFA) by a thermodynamic approach of different glass forming systems. Different GFA parameters and thermodynamic parameter i.e the Gibbs free energy difference, ΔG between the under cooled liquid and the corresponding crystalline state are determined and correlated against critical size (d_c) to predict which parameter better represents GFA of different metallic alloys. A higher value of linear regression coefficient R^2, corresponds to better correlation between d_c and different GFA parameters. The value of R^2 obtained for different GFA parameter is not so high because metallic glasses with large variation in composition are taken into consideration. Hence metallic glasses with different composition will have different GFA.

Different GFA parameters give idea about the GFA of multicomponent metallic glasses. Based on reasonably good correlation with d_c, thermodynamic parameter ΔG reflects the GFA of metallic alloys. As a result, driving force for crystallization is a good indicator for glass forming ability of metallic glasses.

Gibbs free energy difference is the driving force for the crystallization; therefore, lower the value of ΔG, higher is the glass forming ability (GFA) of metallic glasses. Hence, correct prediction of ΔG is important from designing point of view of new glassy materials. The ΔG values can be estimated if one knows the experimental specific heat difference (ΔC_p). However in absence of experimental ΔC_p values, different approximations of ΔC_p with temperature available in the literature are taken into consideration for deriving expression of ΔG. These expressions excellently account for ΔG in multicomponent metallic glass forming alloys in the entire undercooled region.

The GFA of Mg-Ni-Pr based metallic alloys is investigated through ΔG and different GFA parameters. ΔG is the best GFA criterion and Mg-Ni-Pr-based metallic glassy alloys can be successfully fabricated in air due to its high oxidation resistance ability. Also GFA of $Mg_{65}Ni_{21}Pr_{14}$ metallic glass produced in argon is better glass former than $Mg_{65}Ni_{21}Pr_{14}$ produced in air.

Also the GFA of Cu-Pr based metallic glass is studied through ΔG and different GFA parameters. Further the minor addition of elements Ti and B to Cu-Pr based enhances the GFA of alloy.

Critical cooling rate (R_c) is an ideal route to know the GFA of different glass forming systems. The study of TTT diagram of metallic glasses provides better understanding for the theoretical estimation of critical cooling rate (R_c). The determination of R_c for the glass formation for Pd based alloys is reported using TTT curves. Different theoretical models of ΔG in undercooled region of Pd

based metallic glasses are used and incorporated in nucleation and growth equations, corresponding TTT curves are constructed. This work revealed that expression for ΔG derived using hyperbolic variation of ΔC_p is suitable for determining R_c for Pd based metallic alloys. The variation in ΔG affects the value of R_c for glass formation of Pd-based alloys. TTT curves obtained for Cu-Zr binary alloy to determine R_c using Davies Ulhmann formulation. Expressions of ΔG given by Lad et al are used in nucleation and growth equation to determine Rc for Cu-Zr alloys.

Experimentally, the GFA of metallic can be understood by studying the crystallization kinetics of metallic glass. The experimental investigations provide insight of crystallization kinetics of Zr based $Zr_{52}Cu_{18}Ni_{14}Al_{10}Ti_6$ amorphous alloy. Crystallization kinetics is the way to determine the activation energy and other kinetic parameters of the metallic glass. Thus, we can predict glass forming ability and thermal stability of glassy alloy. Crystallization of metallic glasses involves nucleation and growth processes. DSC technique is used to study crystallization kinetics of $Zr_{52}Cu_{18}Ni_{14}Al_{10}Ti_6$ metallic glasses. Different testing techniques have been employed to check the validation of different models. Non-isothermal crystallization studies of the alloy indicates that kinetics conform to Johnson-Mehl-Avrami (JMA) model. The master plot method and normalized heat flow curve proves the validity of JMA model. Analysis of the second crystallization event has been done by using various iso-conversional and isokinetic methods available in literature. Activation energy of crystallization increases, whereas the value of Avrami exponent decreases, with increase in

crystallized fraction. The fitting curve using Lasocka's empirical relation show that the influence of the heating rate for secondary crystallization event is larger than the primary crystallization event.

6.1 Scope for future work

From an overview of the results, it is evident that, there is a scope for future work on metallic systems:

Apart from the thermodynamic properties, magnetic properties of metallic glasses can be studied and electrical conductivity measurement can be done using four probe method.

R_c can be also be determined from other than "nose method" like continuous integral method which is based on Johnson-Mehl-Avrami (JMA) phase transformation model and the classical theory for crystal nucleation and growth.

Corrosion study of the metallic glasses can be carried out in various chemical electrolytes to study its corrosion resistance. The potentiodynamic polarization experiments can be performed to calculate the corrosion resistance of metallic glasses.

Comparative study of crystallization kinetics through DSC and MDSC can be carried out for other samples and how the sinusoidal heating rate effects the kinetic parameters.

Hence, these studies will contribute towards improvement and utilization of the properties of metallic glasses in a more effective way.