**Thermodynamic modelling to predict glass forming composition in quaternary Zr-Cu-Ti-Al system.**

**Yogesh Prabhu 1**

1Department of Metallurgical and Materials Engineering,

Visvesvaraya National Institute of Technology, Nagpur – 440 010, India

*prabhuyogesh27@gmail.com*

**S Vincent 1, E. S. Park2, Jatin Bhatt 3**

1Department of Mechanical Engineering, Birla Institute of Technology and Science, Pilani, Dubai Campus, Dubai, United Arab Emirates.

2Department of Materials Science and Engineering, Seoul National University, South Korea

3Department of Metallurgical and Materials Engineering,

Visvesvaraya National Institute of Technology, Nagpur – 440 010, India

**Abstract**

Presence of amorphous structure in metallic glass results into extraordinary mechanical and chemical properties like high elastic limit, low modulus of elasticity, superior corrosion and wear resistance. These unique combinations of properties appealto the research community for usingmetallic glass as a potential material for biomedical application. Majority of the metallic glasses researched for bioimplant applicationare based on Zr rich compositions. Presence of toxic elements like Ni and Be, which are used to improve the glass forming ability, are not beneficial for such applications [1]. Hence, it is essential to develop Zr-based metallic glass free from toxic elements. In the present study, the thermodynamic model is used to optimize glass forming compositionthat incorporates enthalpy of chemical mixing (∆Hchem), mismatch entropy normalized by Boltzmann’s constant (∆Sσ/KB), and normalized configured entropy (∆Sconf/R) [2]. Using current model criteria, Zr-Cu-Ti-Al system is divided into all possible ternary systems to understand the interaction between ∆Hchem and ∆Sσ/KB in the statistically designed range of ∆Sconf/R from 0.9 to 1.0. Thermodynamic nature of iso-contours is discussed from the view to pinpoint best glass forming composition in Zr-Cu-Ti-Al system. The composition obtained from model is further validated by fabricating metallic glass ribbon by melt spun technique. Structural nature of the glassy ribbon was confirmed by X-ray diffraction, thermal analysis and transmission electron microscope.

***Keyword:*** *metallic glass, thermodynamic modelling, quaternary.*

**References:**

1. M. Hartmann and A. Hartwig, *Carcinogenesis*, **19 (**1996) 617.
2. S. Vincent, D.R. Peshwe, B.S. Murty, J. Bhatt, J.Non-Cryst. Solid.,**357** (2011) 3495-3499