

"Amorphous Materials"

Class # _____ Name _____

1. Fill in the blank. (7 points)

GFA, as related to the ease of (vitrification), is very crucial for understanding the origins of (glass formation) and also important for designing and developing new BMGs. The GFA of a melt is evaluated in terms of the (critical cooling rate) for glass formation, which is the minimum cooling rate necessary to keep the melt amorphous without (precipitation) of any crystals during solidification. The (smaller) R_c , the (higher) the GFA of a system should be. However, R_c is a parameter that is difficult to measure precisely. Unfortunately, there exists no (universal model) to predict the families of alloy composition which are likely to possess good GFA. Through extensive experiments, three empirical rules have been found to favor the formation of bulk amorphous alloy: 1) (multi component) system with more than 3 components, 2) large difference in (atomic size) between constituent elements, and 3) large negative (heat) of mixing in the liquid. These rules are correlated with conditions necessary for (stabilizing) liquid phase and for (retarding) crystallization kinetics of supercooled liquid phase. Amorphous phase formation during solidification under equilibrium conditions, there is competition between several phases and solidification is accompanied by mass transfer of the components. Typical examples are alloy systems with (deep eutectic). In comparison, alloys locating in (single phase) region in equilibrium phase diagram show poor (GFA). Therefore, information on phase diagram is useful to search the potential high GFA composition range in a selected alloy system, satisfying the three empirical rules. Even though (empirical rules) can offer some useful guidelines for alloy design, development of new alloy with large GFA is mainly dependent on the necessary of carrying out a series of experiments where compositions are changed step by step.

universal model / BMG / glass formation / Gibb's free energy / destabilizing / empirical rules / larger / vitrification / multi component / retarding / deep eutectic / enthalpy / critical cooling rate / intermetallic compound / GFA / smaller / critical thickness / precipitation / eutectic phase / entropy / atomic size / glass transition / single phase / Devitrification / higher / stabilizing

2. Describe in detail how to optimize process to improve glass-forming ability. (5 points)

3. Eutectic composition exhibits the highest liquid stability in the alloy system. However, in some cases the best GFA is not shown at the composition, but near the composition. Explain the reason why the alloy composition with best GFA is not always matched with the eutectic composition. (5 points)

4. Ca-Mg-Zn alloy system is one of the potential candidates for new bulk metallic glasses. Discuss why. (3 points)

*** Suggestion for class or request for personal conversation:**