1) Due to your excellent performance in 3.071, you have been tasked with making MSE medallions out of the bulk metallic glass Vitreloy-1 ($Zr_{41.2}Be_{22.5}Ti_{13.8}Cu_{12.5}Ni_{10}$) for the class of 2016. Please name the processing technique(s) you consider appropriate for this project and justify your choice based on what you learnt in 3.071. The Department Chair has generously agreed to finance your project so cost is not a factor you need to consider, although he does want to see the medallions retaining all the nice properties of amorphous metals.

For your information, here is a link showing how the medallions were made out of bronze: http://dmse.mit.edu/news/medallion-casting. The new BMG medallions would certainly last a lot longer!

2) Using the material parameters listed below, plot the volume change of a glass sample as it undergoes the following thermal processes i) and ii). The environmental pressure is held constant at 1 atm throughput the processes.
i) Glass cools down from 1000 K to 600 K at fixed cooling rates of 100 °C/s and 1 °C/s. Also calculate the Fictive temperatures of glasses obtained using the two cooling rates.
ii) Glass cools down from 1000 K to 600 K at a cooling rate of 100 °C/s, then is reheated at a constant rate of 1 °C/s to 800 K, and finally cools down at 1 °C/s to 600 K. What is the Fictive temperature of the sample?
iii) Schematically plot the heat flux released from a glass sample as it undergoes the thermal treatment in ii) and explain the main features (extrema, inflection points, nodes, etc.) on the plot.

Volume coefficient of thermal expansion of supercooled liquid: 10^{-4} / °C
Activation energy of volume relaxation (ΔE_a): 3 eV
Pre-exponential factor of relaxation time (τ_0): 10^{-18} s

3.071 Amorphous Materials

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