Welcome to 3.091

Lecture 21

October 30, 2009

Introduction to Glasses
solid: that which is dimensionally stable, i.e., has a volume of its own

2 classifications of solids by atomic arrangement

<table>
<thead>
<tr>
<th>ordered</th>
<th>disordered</th>
</tr>
</thead>
<tbody>
<tr>
<td>atomic arrangement</td>
<td>regular</td>
</tr>
<tr>
<td>order</td>
<td>long-range</td>
</tr>
<tr>
<td>name</td>
<td>crystalline</td>
</tr>
<tr>
<td></td>
<td>“crystal”</td>
</tr>
</tbody>
</table>

*glass*: solid lacking long-range order
Glass transition temp. $T_g$, fast, slow

$T_{mp}$

Heating curve
Cooling curve

Glass transformation range
Super-cooled liquid
Stable liquid

Process of melting and crystallization

Glass on fast cooling
Glass on slow cooling
Crystal
$V_{xs}$ excess volume

glass transformation range

stable liquid

process of melting and crystallization

glass on fast cooling

glass on slow cooling

$T_g$, slow $T_g$, fast

glass transition temp.

$T_{mp}$ temperature
$V^{xs}$
excess volume

glass on fast cooling

$T_g$, fast

glass on slow cooling

$T_g$, slow

glass transition temp.

$T_{mp}$
temperature

heating curve

cooling curve

stable liquid

process of melting and crystallization

super-cooled liquid

glass transformation range
Properties of Oxide Glasses

1. *chemically* inert
2. *electrically* insulating
3. *mechanically* brittle
4. *optically* transparent
Properties of Oxide Glasses

1. chemically inert
2. electrically insulating
3. mechanically brittle
4. optically transparent

high melting
Metallic Glasses

1959 Prof. Pol Duwez at Cal Tech. made amorphous Aug. Sis.25

Liquid metal

Ribbon, 1 to 5 mm wide

water cooled copper wheel

10 to 80 m s⁻¹

10 to 50 μm

Cooling rate x 10⁶ K/s Rapid Solidification

C.f. Hall telescope at Palomar Observatory, San Diego

Coated over 8 months!
Au-Si Phase Diagram
Magnetoelastic Resonators: Theft Prevention

resonator: 39 Fe, 39 Ni, 2 Mo, 20 B metglass

bias magnet: FeCoCr ductile alloy

antenna/receiver: operates at 58 kHz

1. Pulse excitation signal & listen for resonance (merchandise)
2. Operate excitation continuously & listen for harmonics (library books, videos)