Segregation Science

Science

Segregation is not only a large field, it is also not easily ploughed. Since it is instrumental for *wootz blades*, I will devote several science modules and two special modules to this topic.

1. **Basics of Segregation**.
   Topics covered are: 1. Some basics about segregations. 2. Phase diagrams, "macroscopic" segregation and the segregation coefficient. 3. The flow of energy and particle currents through the solid-liquid interface during freezing - and what it implies.
2. **Constitutional Supercooling and Interface Stability**
   Topics covered are: 1. Non-equilibrium and how systems try to get back to equilibrium. Exploiting the difference between currents and current densities. 2. What is constitutional supercooling and calculations for a simple model. 3. Supercooling, interface stability and dendritic growth plus some remarks to convection in the melt.
3. **Supercooling and Microstructure**.
   Topics covered are: 1 How supercooling plus segregation determines the microstructure of the forming solid. 2. A closer look at what happens when we cast an object. 3. Temperature gradient and interfaces velocity are the most important parameters for the microstructure.
4. **4. Segregation at High and Ambient Temperatures**
   Topics covered are: 1 What could happen during cooling. 2. A simple model for macrosegregation at high temperatures 3. Microsegregation at high temperatures. 4. What is left at room temperature and a simple way to look at the effects of diffusion. The importance of microsegregation for the nucleation of precipitates.
5. **Striations**.
   Striations, an universal expression of microsegregation, are necessary for wootz steel patterns but not contained in the preceding modules. Examples are given and discussed.

Related modules are:

6. **Segregation and Striations in CZ Silicon**.
   Showing that segregation can have major effects - even in almost perfect crystals with very small impurity concentrations - and that it occurs typically in the form of striations
7. **Microsegregation and "Current Burst" theory**.
   Comparing self-organizing features of Si electrochemistry to self-organization features of liquid-solid interfaces, speculating that striations are expressions of stochastic events synchronized by nearest neighbor interactions.