Welcome to 3.091

Lecture 19

October 25, 2004
Taxonomy of Defects: Classify by Dimensionality

0-dimensional: point defects
1-dimensional: line defects
2-dimensional: interfacial defects
3-dimensional: bulk defects
Point Defects
- localized disruption in regularity of the lattice
- on and between lattice sites

1. Substitutional Impurity
- occupies normal lattice site
- dopant ☺, e.g., P in Si; B in C\(_{\text{(diamond)}}\)
- alloying element ☺, e.g., Mg in Al; or Ni in Au
- contaminant ☹, Li\(^+\) in NaCl

2. Interstitial Impurity
- occupies position between lattice sites
- alloying element ☺, e.g., C in Fe; or H in LaNi\(_5\)
- contaminant ☹, H in Fe
Self interstitial

Vacancy

Interstitial impurity atom

Substitutional impurity atom
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- unoccupied lattice site
- formed at time of crystallization
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Point Defects in Ionic Crystals
- special issues associated with the need to maintain global charge neutrality

1. Schottky Imperfection
- formation of equivalent (not necessarily equal) numbers of cationic and anionic vacancies

2. Frenkel Imperfection
- formation of an ion vacancy and an ion interstitial

3. F-Center
- formation of an ion vacancy and bound electron
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