

1.6: Energetics of Surfaces

All surfaces are energetically unfavorable in that they have a positive free energy of formation. A simple rationalization for why this must be the case comes from considering the formation of new surfaces by cleavage of a solid and recognizing that bonds have to be broken between atoms on either side of the cleavage plane in order to split the solid and create the surfaces. Breaking bonds requires work to be done on the system, so the surface free energy (surface tension) contribution to the total free energy of a system must therefore be positive.

The unfavorable contribution to the total free energy may, however, be minimized in several ways:

1. By reducing the amount of surface area exposed
2. By predominantly exposing surface planes which have a low surface free energy
3. By altering the local surface atomic geometry in a way which reduces the surface free energy

The first and last points are considered elsewhere (1.7 Particulate Metals, & 1.6 Relaxation and Reconstruction, respectively) - only the second point will be considered further here.

Of course, systems already possessing a high surface energy (as a result of the preparation method) will not always readily interconvert to a lower energy state at low temperatures due to the kinetic barriers associated with the restructuring - such systems (e.g. highly dispersed materials such as those in colloidal suspensions or supported metal catalysts) are thus "metastable".

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