Eutectic point explained

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Electron Affinity - The electron affinity is the potential energy released when an ...

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A eutectic system or eutectic mixture (/ju:'t?kt?k/ yoo-TEK-tik)[1] is a type of a homogeneous mixture that has a melting point lower than those of the constituents.[2] The lowest possible melting point over all of the mixing ratios of the constituents is called the eutectic temperature. On a phase diagram, the eutectic temperature is seen as the eutectic point (see plot on the right).[3]

Non-eutectic mixture ratios have different melting temperatures for their different constituents, since one component''s lattice will melt at a lower temperature than the other''s. Conversely, as a non-eutectic mixture cools down, each of its components solidifies into a lattice at a different temperature, until the entire mass is solid. A non-eutectic mixture thus does not have a single melting/freezing point temperature at which it changes phase, but rather a temperature at which it changes between liquid and slush (known as the liquidus) and a lower temperature at which it changes between slush and solid (the solidus).

In the real world, eutectic properties can be used to advantage in such processes as eutectic bonding, where silicon chips are bonded to gold-plated substrates with ultrasound, and eutectic alloys prove valuable in such diverse applications as soldering, brazing, metal casting, electrical protection, fire sprinkler systems, and nontoxic mercury substitutes.

The term eutectic was coined in 1884 by British physicist and chemist Frederick Guthrie (1833-1886). The word originates from Greek e?- (e?) "well" and t?x?s (t?xis) "melting".[2] Before his studies, chemists assumed "that the alloy of minimum fusing point must have its constituents in some simple atomic proportions", which was indeed proven to be not the case.[4]

The eutectic solidification is defined as follows:[5]

This type of reaction is an invariant reaction, because it is in thermal equilibrium; another way to define this is the change in Gibbs free energy equals zero. Tangibly, this means the liquid and two solid solutions all coexist at the same time and are in chemical equilibrium. There is also a thermal arrest for the duration of the phase change during which the temperature of the system does not change.[5]

The resulting solid macrostructure from a eutectic reaction depends on a few factors, with the most important factor being how the two solid solutions nucleate and grow. The most common structure is a lamellar structure, but other possible structures include rodlike, globular, and acicular.[6]

Compositions of eutectic systems that are not at the eutectic point can be classified as hypoeutectic or hypereutectic:

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