

# Thermodynamic Stability MAPS: A Powerful Engineering Design Tool

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## Abstract

The first phase of a typical plan for an innovative device or advanced structure start with a paper outline of what is to be achieved and how it will surpass the current technology. At this stage all looks well and eminently doable. However, advanced and innovative structures typically involve newer material sets or as yet unproven applications of current materials and this is where problems tend to arise. Introducing different materials into an existing structure tends to introduce as yet unforeseen material incompatibilities which can lead to delaminations, fracture or a host of other problems.

One method for overcoming these obstacles is through the use of thermodynamic stability maps which are generated through a process of materials characterization and computer modeling. The stability map can be thought of as a guide through the minefield of materials related thermodynamic instabilities that can derail development programs, cause interruptions in manufacturing or in a worse case give rise to delayed failure after product has shipped.

The stability map idea leads to the concept of "Engineering Design for Unconditional Structural Stability in Regard to All Anticipated Loading Conditions". A detailed example will be given for the case of soldering pins onto a large multichip module where the failure of even one pin could destroy the modules functionality and the module was too expensive to simply discard.