Normalized Free Energy and Normalized Entropy Applied to Some Lambda-Transitions

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From the Gibbs-Helmholtz equation one obtains an equation for normalized free energy and normalized entropy. This shows that for a given system the fractional available energy plus the fractional unavailable energy is equal to unity. The concept is applicable to many systems. This is comparable to a classical probability equation for tossing coins. Normalized parameters allow a simple conceptual understanding of the familiar lambda- anomaly of a heat capacity curve of an equilibrium system. It is shown that the normalized parameter relationships for lambda-anomalies of the heat capacity curves for superfluidity of helium-4, and those for typical superconducting materials are equivalent. Recently Phillips and Dalidovich [1] discussed the unexpected occurrence of a metallic phase between the insulator and superconductor phases of some thin film materials. With appropriate thermodynamic definitions one finds that an intermediate metallic phase is expected in such systems. It is possible to thermodynamically characterize and show qualitative relationships of insulator, metal, and superconducting states without appeal to band gap, or energy band considerations. The normalized parameters are comparable in some respects to free energy and entropy of formation. For appropriate conditions they can be used to calculate the normalized free energy and normalized entropy of a chemical reaction. A normalized equation can be given in matrix form. This provides a concise description of a chemical reaction.

[1] P. Phillips and D. Dalidovich, Science **302** , 243 (2003)