Correlating the Influence of Electromagnetic Fields on Solute Content in Metals Using the Thermodynamic Auxiliary Work Functions

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The auxiliary work functions (Gibbs Free Energy and Helmholtz Free Energy) allow establishing an analytical approach, using chemical thermodynamics to guide experimental design and give insight to interstitial solute content in alloys. The Gibbs Free Energy has been the major relationship for estimating electrochemical reactions through the Nernst Equation. The Gibbs Free Energy is an effective auxiliary function for systems experiencing external work. This function has been used to correlate thermoelectric power (Seebeck) coefficient to nitrogen content in austenitic stainless steel weldments and hydrogen content in hydrogen storage and structural materials. The Helmholtz Free Energy, which is the auxiliary function for the total work (including internal work), has been applied to assess the influence of magnetism on hydrogen content in linepipe steel. The analytical approach will be described and examples given of application to hydrogen storage and structural alloys.