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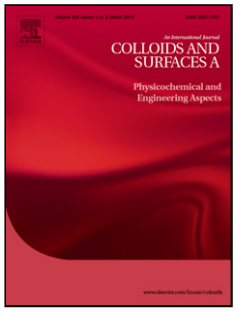

Title: Derivation of the Butler equation from the requirement of the minimum Gibbs energy of a solution phase, taking into account its surface area

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Derivation of the Butler equation from the requirement of the minimum Gibbs energy of a solution phase, taking into account its surface area

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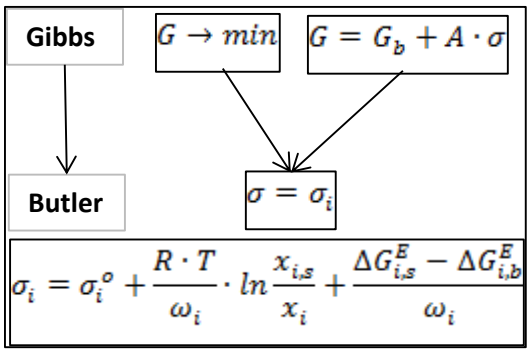
Graphical abstract



Abstract

The Butler equation (on the equality of the partial surface tensions of the components of a solution) is derived in this paper from the general requirement that in equilibrium the Gibbs energy of the solution phase (taking into account also its surface area) must have a minimum value. This new derivation hopefully will increase the confidence of the scientific community in applying the Butler equation in further calculations of surface tension and surface adsorption (and also surface phase transition) of liquid solutions and in extending it to other interfaces.

Keywords: surface tension; surface adsorption; solutions; Gibbs thermodynamics, Butler equation

1.Introduction

Surface tension [1-5] and surface adsorption [6-9] are the basic concepts of colloid and surface sciences. The Butler equation [10] is routinely used by many researchers to calculate surface segregation, surface adsorption and surface tension of liquid solutions [11-66]. The Butler equation was extended to calculate surface phase transition at liquid surfaces [67-68]