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ABSTRACT:

Transient-state methods to determine all the mass/charge transport properties of an inorganic compound

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All the mass/charge transport properties of an inorganic compound with single-type ions(i) and holes(h) as mobile charged components, e.g., $\{O^{2-},h^{+}\}$, may be exhaustively and succinctly documented in terms of a coupling coefficient matrix L of the Onsagarian causality as [1]

$$\begin{pmatrix} J_i \\ J_h \end{pmatrix} = \begin{pmatrix} L_{ii} & L_{ih} & L_{iT} \\ L_{hi} & L_{hh} & L_{hT} \end{pmatrix} \begin{pmatrix} -\nabla\eta_i \\ -\nabla\eta_h \\ -\nabla T \end{pmatrix}.$$

where, J_k and η_k denote the flux and electrochemical potential of the mobile charged-component k(=i,h), respectively, and T the absolute temperature. Due to the Onsager reciprocity [2] and the L-matrix transformation rule [1], respectively,

$$L_{ih} = L_{hi} \quad ; \quad \begin{pmatrix} L_{iT} \\ L_{hT} \end{pmatrix} = \begin{pmatrix} L_{ii} & L_{ih} \\ L_{hi} & L_{hh} \end{pmatrix} \begin{pmatrix} \bar{\bar{S}}_i \\ \bar{\bar{S}}_h \end{pmatrix}$$

where, due to Wagner, [3] $\bar{\bar{S}}_k$ is the transported entropy of k, the sum of its partial entropy, $\bar{S}_k$ and entropy-of- transport, S_k^* or

$$\bar{\bar{S}}_k \equiv \bar{S}_k + S_k^* \ ; \ S_k^* \equiv q_k^* / T$$

with q_k^* being the reduced heat-of-transport of k(=i,h).

In this talk, we will introduce the transient-state methods to determine once and for all all the mass/charge transport properties $\{L_{ii},L_{ih}(=L_{hi}),L_{hh};L_{iT},L_{hT}\}$, together with their experimental

implementations based on the isothermal semi-blocking polarizations and nonisothermal polarizations or thermopowers.

[1] T. Lee, H.-S. Kim and H.-I. Yoo, Solid State Ionics, 262, 2 (2014).
[2] D.-K. Lee and H.-I. Yoo, Phys. Rev. Lett., 97, 255901 (2006).
[3] C. Wagner, Prog. Solid State Chem., 7, 1 (1972).