

Transport Equations and Coefficients for Active Transport and Thermogenetic Activity of Ca-ATPase Isoforms

Signe Kjelstrup^{C, S}

Department of Chemistry, Norwegian University of Science and Technology, Trondheim, Realfagbygget, Norway

Daniel Barragan

Department of Chemistry, National University of Colombia, Bogota, CO, Columbia

Dick Bedeaux

Department of Chemistry, Norwegian University of Science and Technology, Trondheim, Realfagbygget, Norway

The Ca-ATPase in sarcoplasmic/ endoplasmic reticulum (SERCA) is a molecular pump, responsible for so-called active transport of Ca^{2+} against its concentration gradient, by means of chemical energy from hydrolysis of adenosine triphosphate (ATP) to adenosine diphosphate (ADP). It well documented in the literature that heat is produced during this process, and that the ion pump and chemical reaction as well as the heat production can be reversed. The equations used so far to describe these non-linear phenomena, have lacked a thermodynamic basis. Such a basis has now been developed (1-3), and its most recent formulation (3) shall be presented. We shall also present transport coefficients for active transport and thermogenetic activity using experimental data in the literature. We show that the transport coefficients derived can be used to characterize the isoforms of SERCA obtained from different tissues, compatible with their postulated physiological role. The coefficients may also be useful in systems biology for modeling purposes.

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