ABSTRACT:

Bioengineering Thermodynamics Approach to Cell Systems: Thermal Resonance in Cancer Analysis

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Cells function as open thermodynamic systems where various energy conversions, thermo-electro-chemical processes, and transport mechanisms take place across their membranes. Notably, there are distinct differences in thermo-electro-biochemical behaviours between healthy and diseased states. Living organisms inevitably generate waste heat due to internal irreversibility, which dissipates into the environment. This heat loss represents a flow of information from the cell to its surroundings, observable by external observers. Investigating this irreversibility and the heat generated can provide a novel perspective on cellular behaviour. This approach views living systems as black boxes, concentrating on their inputs and outputs and how these shift in response to environmental changes. By analysing alterations in heat waste due to external influences, significant insights into the system can be attained. This paper reviews recent research findings using this method, highlighting its thermodynamic relevance and the potential emergence of a new domain known as bioengineering thermodynamics. Selected experimental results from our research are summarized and discussed to support the methodology employed.