Abstract

Non-equilibrium thermodynamics, which serves as a framework for formulating evolution equations of macroscopic and mesoscopic systems, is briefly reviewed and further developed in this work. For example, the relation between the General Equation for the Nonequilibrium Reversible-Irreversible Coupling (GENERIC) and (ir)reversibility is elucidated, and Onsager-Casimir reciprocal relations are shown to be an implication of GENERIC. Non-equilibrium thermodynamics is then applied to describe fuel cells and related devices, and theoretical conclusions are compared to experimental data. Moreover, a generalization of standard exergy analysis is developed bringing a new method for revealing a map of useful work losses in electricity producing devices. This method requires a non-equilibrium thermodynamic model, and so the general theory of non-equilibrium thermodynamics and optimization of real power generating devices stand side by side.