



Contribution ID: 15

Type: **Talk**

Thermodynamic Efficiency in Dissipative Chemistry

Thursday, 19 September 2019 12:20 (20 minutes)

Chemical processes in closed systems inevitably relax to equilibrium. Living systems avoid this fate and give rise to a much richer diversity of phenomena by operating under nonequilibrium conditions. Recent experiments in dissipative self-assembly also demonstrated that by opening reaction vessels and steering certain concentrations, an ocean of opportunities for artificial synthesis and energy storage emerges. To navigate it, thermodynamic notions of energy, work and dissipation must be established for these open chemical systems. Here, we do so by building upon recent theoretical advances in nonequilibrium statistical physics. As a central outcome, we show how to quantify the efficiency of such chemical operations and lay the foundation for performance analysis of any dissipative chemical process.

Summary

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Session Classification: Session 3