Scaling and Renormalization in the Kinetics of Rate Processes

Valter Henrique Carvalho-Silva [(a)], Vincenzo Aquilanti [(b)]
[(a)] *Laboratory for Modeling of Physical and Chemical Transformations, Goiás State University, 75132-903, Anápolis, Brazil.*
[(b)] *Dipartimento di Chimica, Biologia e Biotecnologie, Università di Perugia, 06123, Perugia; Istituto di Struttura della Materia, Consiglio Nazionale delle Ricerche, 00016, Rome, Italy*

Scaling and renormalization theory have been extended to modern rate processes. These concepts have proven useful in extreme conditions, where the Arrhenius formula for temperature dependence of rates is violated and scaled parameters have simplified the identification of universalities in the kinetics of these processes. One important concept is the apparent activation energy (Ea), which eliminates the compensation effect and ensures the appropriate rate law over a wide temperature range. However, singularities at low temperatures can only be removed through the reciprocal of Ea, the transitivitiy function. Furthermore, their differential equations are coupled to allow interpretation of the microscopic foundation of curvatures in scaled planes, creating conditions for arranging a renormalization theory in the kinetics of rate processes. This formulation has been applied to assessment of universality classes in quantum tunneling regime, biophysical processes and glass-forming liquids.