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The 'fractional' kinetic equations and general theory of dielectric relaxation

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Abstract

Based on the Mori-Zwanzig formalism it becomes possible to suggest a general decoupling procedure, which reduces a wide set of various micromotions distributed over a self-similar structure to a few collective/reduced motions describing the relaxation/exchange behavior of a complex system in the mesoscale region. The frequency dependence of the reduced collective motion contains real and pair of complex-conjugate power-law exponents in the frequency domain and explains naturally the "universal response" (UR) phenomenon discovered by A. Jonscher in a wide class of heterogeneous materials. This strict mathematical result allows in developing a consistent and general theory of dielectric relaxation that can describe wide set of dielectric spectroscopy (DS) data measured in some frequency/temperature range in many heterogeneous materials. Based on this result it becomes possible also to suggest a new set of two-pole elements, which generalizes the conventional RLC-elements and can constitute the basis of new theory of the linear electric circuits.

Keywords

Fractional kinetic equations with non-integer real and complex-conjugate exponents, General theory of dielectric relaxation of non-crystalline materials, The generalized reind/recap element