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Abstract

The Causality-Composition Law in the Non-Debye Relaxations Models †

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The standard approach to represent the experimentally measured data depending on some continuous parameter is to draw them as a curve, i.e. as a continuous function which fits the experimental points and hopefully follows some theoretical explanation. The most typical illustration of such procedure is a graphical representation of the time evolution of some physically relevant quantity. However, any time evolution pattern must satisfy a crucially important condition: its initial point may be chosen arbitrarily but has to be earlier than the final point. Thus, we can say that any result must not precede its cause and the fitted curve is to satisfy the causality law. This requirement leads also to the composition law. Namely if the system evolves from t0 to t such that t0 < t and if we choose an intermediate instant of time tint, t0 ≤ tint ≤ t, then the composition of evolution in the intervals (t0, tint) and (tint, t) must give the same result as the evolution in the interval (t0, t). This basic property, easily seen for the Debye, i.e. exponential law, is not so evident for non-Debye relaxation phenomena. We show explicitly how it is realized in two non-Debye relaxation patterns widely used in dielectric physics, namely the Cole-Cole model and the Kohlrausch-Williams-Watts (stretched exponential) model observed in the photoluminescence.

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