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Editorial

Failure-Oriented-Accelerated-Testing (FOAT) and its Role in Reliability Physics of Electronic and Photonic Materials, Packages and Systems

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"There is nothing more practical than a good theory"

Kurt Zadek Lewin, German-American psychologist (1890-1947)

An highly focused and highly cost effective failure-oriented-accelerated-testing (FOAT) [1] was suggested about a decade ago as an extension and a modification of highly accelerated life testing (HALT) [2] and as an experimental basis of the novel probabilistic design for reliability (PDfR) concept [3]. Such testing is intended to be carried out at the design stage of a new electronic, photonic, MEMS and MOEMS (optical MEMS) technology or a new design, when high operational reliability (like the one required, e.g., for aerospace, military, or long-haul communication applications) is a must. On the other hand, burn-in-testing (BIT) [4] that is routinely conducted at the manufacturing stage of almost every IC product since the very beginning of the electronics engineering era is also of the FOAT type: it is aimed at eliminating the infant mortality portion of the bathtub curve by, hopefully, getting rid of the low reliability "freaks" prior to shipping the "healthy" products, i.e., those that survived BIT, to the customer(s). It is noteworthy that some of the product development tests, such as, e.g., shear-off or temperature cycling tests, are also of the FOAT type. When FOAT is conducted, a physically meaningful constitutive equation, such as, e.g., the multi-parametric Boltzmann-Arrhenius-Zhurkov (BAZ) [5] model, should be employed to predict, from the FOAT data, the probability of failure and the corresponding useful lifetime of the product in the field, and, from the BIT data, as has been recently demonstrated [6], - the adequate level and the duration of the applied stressors, as well as the (low, of course) activation energies of the "freaks". In the author's opinion, the application of the PDfR concept, FOAT technique at the design stage and the application of BAZ constitutive model put the art-and-science of the microelectronics and photonics reliability engineering on a consistent and "reliable" ground. The FOAT at the design and at the manufacturing stages of a product of importance have been addressed using analytical ("mathematical") predictive modeling [7,8]. Predictive modeling should always be conducted prior to and during the actual testing, and analytical ("mathematical") modeling should always complement computer simulations. These two major modeling tools are based on different assumptions and use different calculations techniques, and if the output data obtained using these tools are in agreement, then there is a good reason to believe that these data are sufficiently accurate and trustworthy.

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