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Editorial

Failure Oriented Accelerated Testing and its Role in Understanding and Assuring Reliability of Electronic and Photonic Products

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Understanding the reliability physics is critical for making a viable "high-tech" device into a reliable product, isn't it? On the other hand, it is, as is known, the properly designed, carefully conducted and correctly interpreted accelerated testing that is the "supreme and final judge" of the product's reliability. An highly focused and highly cost effective failure-oriented-accelerated-testing (FOAT) [1,2] suggested about a decade ago as an experimental basis of the novel probabilistic design for reliability (PDfR) concept [3] is intended to be carried out at the design stage of a new electronic, photonic, MEMS and MOEMS (optical MEMS) technology and when high operational reliability (like the one required, e.g., for aerospace, military, or long-haul communication applications), especially when instrumentation and human performance contribute jointly to the outcome of an aerospace or a military undertaking [4], is a must. On the other hand, burn-in-testing (BIT) [5] that is routinely conducted at the manufacturing stage of an "high-tech" product is also of FOAT type: it is aimed at eliminating the infant mortality portion of the "reliability passport" of an electronic or a photonics product -the bathtub curve (BTC) - by trying to get rid of the low reliability "freaks" prior to shipping the "healthy" products, i.e., those that survived BIT, to the customer(s). Some of the product development tests, such as, e.g., shear-off tests 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) model [6], should be employed to predict, from the test data, the probability of failure and the corresponding useful lifetime of the product in the field, and/or, from the BIT data, as has been recently demonstrated [5], the adequate level and duration of the applied stressors, as well as the (low, of course) activation energies of the "freaks". The FOAT at the design and the manufacturing stages of a product of importance were recently addressed in detail using analytical ("mathematical") predictive modeling [7]. It is imperative that predictive modeling is always conducted prior to and during the actual accelerated testing, and particularly of the FOAT type, and that analytical modeling complements 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, hence, trustworthy. Future work should be focused on the development of experiments in the light of the obtained findings and recommendations.

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