High resolution Nano-CT to detect and analyze counterfeit semiconductors across multiple size scales from package to internal structures

Dominik Müller[1], Andreas Balles[1], Astrid Hölzing[1]

[1]Nano-CT Systems, Fraunhofer EZRT, Germany

Counterfeit ICs pose a severe risk in terms of reliability and security. Since their identification is very challenging and complex, several well established inspection methods are employed to face this task. So far, two- and three-dimensional X ray imaging is used to verify structural parameters of the entire IC related to the die (size, orientation, cracks, delamination) or bond wires (quantity, broken wires). In order to examine ICs beyond this macroscopic scale, i.e. analyzation of the ICs subcomponts in the metallization layer, resolutions higher than 0.5 µm (limit of modern micro-CT systems) are necessary. State-of-the-art X-ray microscopes provide resolutions in the range of 150 - 50 nm, but due to their technical design, these microscopes are limited in the used X-ray energy (typically <10keV) and therefore considerably limited in sample size. Our self-developed nano-CT instrument, named ntCT, represents a complementary system, which overcomes this gap in resolution and samples size due to its variable field of view (approx. 10 mm - 200 µm) and resolution down to 150 nm. Therefore, here we would like to present the continuous ongoing development of the device and the range of performance verification. Due to its direct converting photon-counting detector, the ntCT system is capable of using almost the entire photon spectrum generated by the used nanofocus X-ray tube. Hence, it is well suited for analyzing a wide range of sample dimensions from microelectronic samples (several hundred microns diameter) up to entire dies (several mm). Here we would like to review the potential of nano-CT for analyzing and examining counterfeit microchips. Specific we examine different Serial to USB converter from FTDI which we have purchased on the marked. We show an authentic chip and compare it to potential counterfeit products. Hierarchical three-dimensional CT examinations ranging from 2 µm down to 150 nm resolution will reveal differences in size and layout, but also in the structure of specific subcomponents in the die.