

DNA tags to secure microelectronics: Counterfeiting, supply-chain security and the cyber threat

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DNA taggants are engineered nucleotide sequences often used as surrogates for native DNA, especially in man-made materials. The application of sequence-specific DNA taggants permits the later identification of the market part and its association with specific metadata. Specific chemistries of DNA derivatives and formulation of carrier systems allows for the creation of robust DNA taggants that easily survive most, if not all, the manufacturing conditions associated with the production and use of microelectronics. Use levels of DNA taggants are typically 1 part per 10^{12} ; at this extraordinarily low level, the DNA taggants are agnostic to production and function.

DNA taggants can be made in nearly infinite variety by changes in length, sequence and the capacity to identify multiple tags via multiplex polymerase chain reactions (PCR) and combinatorial marks. Given their low use levels, current manufacturing methods can provide essentially infinite quantities.

In 2012, the Defense Logistics Agency (DLA) mandated the use of DNA taggants on all microcircuits within Federal Supply Class (FSC) 5962. Subsequently, DNA marking began for 32 individual suppliers. Recently in combination with DLA, the Office of the Secretary of Defense and the Missile Defense Agency have begun working to consolidate DNA marking locations, while expanding DNA marking to an addition 66 FSCs.

DNA sequences share qualities with binary code – they are linear, but with at least 4 options per bit. Encryption keys allow for the storage of 500 Kb of alphanumeric content, even in short sequences. When DNA "bar codes" are combined with machine-readable codes, cloud-based storage combined with DNA metadata can be used for tracking through every step of the supply chain, while DNA provides proof of authenticity.

DNA taggants can be more robust than the genomic DNA found in amber and paleontological samples when properly formulated in anhydrous carriers. We have reported the inclusion and recovery of DNA taggants from plasma-activated and laser-etched surfaces, in extruded plastics, in ink-jet inks and the military-specification epoxy-acrylate UV-cured and thermoset inks

DNA adducts with fluorophores, chromophores, or up-converting phosphors allow for rapid screening methods to prove a DNA taggant is present. Recent developments in nanopore-based NexGen sequencing and portable PCR allow forensic authentication and decryption of DNA taggants on site.