Covert Thermal Barcode Based on Phase Change Nanoparticles

TITLE
Nanoparticle-Based Taggant Systems and Methods

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PATENT STATUS
Filed September 24, 2013

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Covert Thermal Barcode Based on Phase Change Nanoparticles Allows Enhanced Security

BACKGROUND

Considering the growth of world wide security breaches and threats, there exists an unmet forensic need for covert taggants that can be used by law enforcement, national security, or drug manufacturing. Covert taggants can be used to solve very challenging forensic issues such as identification of criminal or terrorism activities, authentication of government-issued documents, authentication of drugs and other valuable commercial products, detection of tampering of containers or restricted areas, or locating suspects in various crimes.

Existing identification techniques, widely used in overt labeling, are not appropriate for covert operations due to limitations of large size, visibility, high cost, and possible loss of intergrity. The current invention overcomes these limitation with a tagging/barcoding system that uses combinations of nanoparticles with different phase change temperatures.

SUMMARY

- A taggant includes a one of more phase change nanoparticles with unique, thermophysical properties.
- The nanoparticles are directly used or are encapsulated in silica or polymer microspheres.
- The nanoparticle can be on the surface of the object or embedded into the object.
- Once a phase change occurs, heat is released or absorbed, producing a measurable and detectable thermal signal.
- A signal transduction mechanism is used to detect phase changes of the nanoparticles, where the melting temperature and fusion enthalpy of each nanoparticle is derived. using Different Scanning Calorimetry (DSC).
- Object is identified by matching the thermal readout of the article with a thermal readout in a library of thermal readouts.

ADVANTAGES

- Various types of available phase change materials can be use as nanoparticles.
- Small size allows use in combination, a high coding capacity, and high discretion.
- Discrete, well-characterised melting points.
- Quick and efficient process for readout.
- Multi-functional taggants, which offer multi-layered authentication, can be made by embedding multiple layers of nanoparticles (such as magnetic and flourescent nanoparticles) together with the phase change nanoparticles.
- At room temperature, nanoparticles can withstand extreme weather conditions with expected lifetime as long as several years.
- Extremely difficult or impossible to reverse-engineer, thus allowing increased protection.