National Institute of Justice

Award Title: Encapsulated phase change nanoparticles as thermally-readable covert taggants

Award Description:

There is an unmet forensic need to develop new covert taggants that can be used robustly and effectively by law enforcement to identify criminal/terrorist, track-trace objects, authenticate documents, and detect tamper activities, etc. Although nanoparticles have shown great potentials as covert taggants, the use of nanoparticle to tag each object in a large group of objects is limited due to lack of nanoparticle-specific property, and low level of multiplicity (small coding space). The New Investigator project is to create a new nanoparticle-based covert taggant system, where a panel of phase change nanoparticles (i.e., metals and eutectic alloys) that have sharp and discrete melting peaks will be encapsulated in silica or polymer microspheres, and use as covert taggants (smart dusts). A new signal transduction mechanism (i.e., thermal readout) will be used to readout taggants by detecting solid to liquid phase changes of nanoparticles, where the melting temperature and fusion enthalpy of each type of nanoparticles will be derived by using different scanning calorimetry (DSC). Magnetic or semiconductor nanoparticles will also be encapsulated in microspheres together with phase change nanoparticles, forming multi-functional taggants that can be used to achieve multi-layered authentication. The goals of this project are: (1) to demonstrate that colloid synthesis method can be used to construct millions of unique, information-rich, and covert thermal taggants, (2) to confirm that thermal taggants can be easily incorporated into real world items, and (3) to test whether thermal taggants can be recovered, detected and decoded from tagged items. The unique combination of several characters including high multiplicity, high sensitivity, covertness, low-cost, ease-of-use, track-trace ability, stability, and transferability in thermal taggants allows forensic investigations to be carried out at high efficiency, less risk and low cost. The concept of thermal taggant is new, potentially transformative, and can be applied to many forensic science areas.
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