Nanotechnology as a tool to end counterfeiting

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Over the past decade, there have been a considerable number of anti-counterfeiting techniques developed to counter theft of brand and intellectual property. Nonetheless, the market for counterfeit and pirated product in 2012 was estimated in up to USD 250 billion, meaning the 2% of the worldwide market. Moreover, this matter has a significant socio-economic effect such as employment, brand value or firm reputation. Health and safe are also very important issues when counterfeit items are medicines and drugs [1]. In this work we review the input of different nanotechnologies applied in the anti-counterfeiting industry.

Nanoscience involves the ability to identify and control individual atoms and molecules allowing, to engineer different structures at the nanoscale which exhibit specific optical, mechanical, magnetic or electrical properties that their macroscopic counterparts (bulk) do not. The analytical complexity to characterize many nanomaterials which may be used as labels or tags, requires highly sophisticated equipment including high-resolution electron microscopes, surface analysis focused on only a few nanometers in depth (XPS), atomic analysis and specific analytical and crystalline characterization (EDX, XRD), which are not easily reachable in common chemical laboratories hampering the process of counterfeiting.

We may distinguish several different nano-based technologies in use nowadays: nanobarcodes, nanoholograms, quantum dots based markings, nanoinks, magnetic fingerprints and more. In case of magnetic firgenprinting, one of the used nanomaterials are superparamagnetic nanoparticles [2-4]. This superparamagnetic behavior exhibited by only few materials at nanoscale differs from other materials at microscale in its high magnetic susceptibility and very low or even zero coercitivity at room temperature as shown for magnetite particles (Figure 1). Due to their lack in remanent magnetization, superparamagnetic nanoparticles allow us to distinguish them from ferromagnetic materials with the appropriate equipment.

Finally, the combination of nanomaterials with different properties (optical and magnetic) or multifunctional nanoparticles displaying any or both properties in the same particle can be used as markers (many times invisible to the naked eye) on a variety of supports (paper, textiles, polymers, etc.), creating countless of unique 'fingerprints', each for every different item, and extremely difficult to copy.

Figures

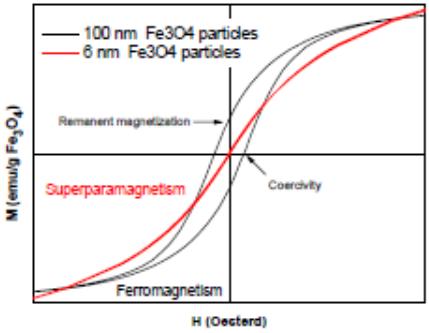

Figure 1: Magnetization curves of 6 nm and 100 nm magnetite particles.

References

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