

# Chapter 12

## Nanotech and Document Security

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### ABSTRACT

*Being a multidisciplinary field, forensic science has greatly evolved over the previous decades. The recent advances in nanotechnology have opened new windows for forensic sciences as it offers cutting-edge methods for simplifying the laborious forensic analysis of the questioned documents. In this regard, various nanoparticles are most widely exploited and coupled with the traditional methods for resolving cases marked with forgery. These methods are now emerging to be the extensively used strategies for the future analysis of questioned documents to obtain the analytical, quantitative, as well as qualitative profile of the ink on real samples. This chapter thus explores the trending (traditional as well as novel nano-based) methods used so far in the questioned documents analysis.*

### INTRODUCTION

The inks evaluation on questioned documents is decisive, especially when the artifices of scripts are involved. Ink analysis has remained challenging forensically due to the non-specificity between the inks. Almost, all the inks contain the same basic composition with trace differences. These differences could not be exploited to serve forensic needs by conventional techniques. In addition, most of the traditional methods for ink analysis are destructive further limiting its application in forensic testing. Therefore, the application of nanotechnology can be employed to uncover the potential of ink analysis and ink aging as corroborative evidence. Nanotechnology has gained popularity in the Forensic community due to its

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ability to produce, easy, quick, economical, and reliable results. Nano-based testing offers the benefit of not needing any pre-treatment process, which ensures that the original document remains intact and unaltered during the analysis. This means that the inks present on the document can be directly examined without any risk of damaging or compromising the integrity of the document. Gold and platinum nano-composites can be utilized to analyze various sources of blue ink and estimate the aging parameter. This means that by using these nano-composites, it is possible to identify the origin of blue ink on a document and estimate how old the ink is. Nano composites are materials made by combining two or more types of nanoparticles. These composites are widely used in the analysis of inks due to their ability to enhance the sensitivity of detecting even minor differences between inks. By combining the unique properties of different nanoparticles, nano composites amplify the detecting properties of the inks and enable more accurate identification of the origin and properties of the inks present on a document.

It is common for forensic laboratories to encounter ink-related evidence that stems from the use of pens during their investigations (Calcerrada & García-Ruiz, 2015). The examination of inks is a very important forensic process that can describe beneficial facts about a questioned document. A “questioned” document can be any communication presented in document form whose source or legitimacy is unsure and it may include suicidal notes, wills, death certificates, threatening letters, insurance claims, checks, petitions, lottery voucher, etc. which can be found in different criminal inspections (Braz et al., 2013). Document analysis starts by identifying the device used to produce the document. Next, a thorough examination of the inks is conducted to detect any changes or additions to the original content. This process involves analyzing the chemical and physical properties of the inks, as well as their relative ages and contributions to the document. By examining the chronological sequence of the ink contributions, it becomes possible to determine the order in which different portions of the document were written. All of these steps are necessary to ensure accurate document analysis and interpretation (Jones et al., 2006). Table 1 defines and elaborates the various relevant terminologies.

*Table 1. Definitions of important terminologies*

Technical Terms	Definition
Question Documents	A questioned document is a type of document that is often linked to criminal or civil investigations and is the subject of a dispute regarding its authenticity or origin.
Forensic Ink Analysis	It is the scientific examination of ink to determine if a document is authentic or has been forged.
Ink Dating	Ink dating is the forensic analysis of ink to determine document age or authenticity.
Nanoparticles:	Nanoparticles are extremely small particles, ranging from 1 to 100 nanometers in size, with unique physical and chemical properties.
Nanohybrids	Materials with organic and inorganic components that are linked together either by noncovalent bonds or covalent bonds at the nanometer scale are called nanohybrids.
Potentiometer	A potentiometer is an instrument used to measure voltage or potential difference by comparing an unknown voltage to a known reference.

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