

Title: Natural Deep Eutectic Solvent-Integrated Sensors: Emerging Trends and Sustainable Solutions for Pharmaceutical Sensing

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Abstract: This investigation concerns a novel possibility in examining the authenticity of ink-print media, acknowledging that within such printed material there could well be items for which cultural heritage may be claimed. A key study feature is that within the printed page it is the ink that provides the greatest localization of carbon content. Underpinning the work is use of Raman spectroscopy in inspecting the ink, the carbon revealing the storing of defects accumulated over time from exposure to the natural background radiation that prevails. This realization points to a possibility for use of this in provenance studies based on the age of a document. Prior studies have shown that atomic displacements, and the associated increase in defect density that occur over time, arise out of such low linear energy transfer (LET) irradiations. Underpinned by the need for the long-term storage of the defects to endure over periods of many hundreds of years and more, the central question tested is whether interrogation of the carbon-rich ink provides sufficient basis to allow detection of these time-dependent alterations. Accordingly, we report results from an exploratory study of book-print ink in European texts, obtained using a small set of personally acquired books published between the late 16th and early 19th centuries. Across the 200-year period of study a steady reduction is found in the integral intensity of the Raman spectrum of the ink, decreasing as a function of recency, amounting to an overall estimate of some 30 %.

Keywords: Carbon Ink Natural background, Raman spectrum, Age-approximation

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