A STUDY PROTOCOL FOR AN INTEGRATIVE FORENSIC SPECTROSCOPIC ANALYSIS OF PEN INKS

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INTRODUCTION

The forensic examination of inks is a cornerstone of questioned document analysis, providing essential evidence in cases involving identity forgery, document alteration and falsification of legal documents. The spectroscopic analysis of pen inks used for this purpose typically combines multiple complementary non-destructive analytical techniques (UV-Vis, FTIR and Raman spectroscopy) to characterize and differentiate inks in suspect documents. These approaches are based on the output combination of different analyses which can allow the improvement of the discrimination of visually identical inks [1-3] based on chemical composition, optical properties and spectral signatures of ink formulations .

OBJECTIVE

Ink Sample Discrimination and Classification

Evaluation of different commercial pens containing blue and black ink and a set of synthetic dyes.

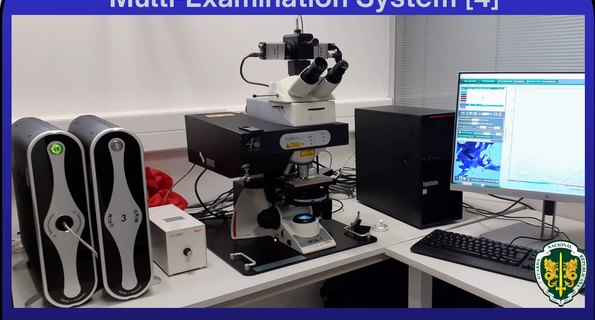
PROTOCOL PROPOSAL

Materials and Methods

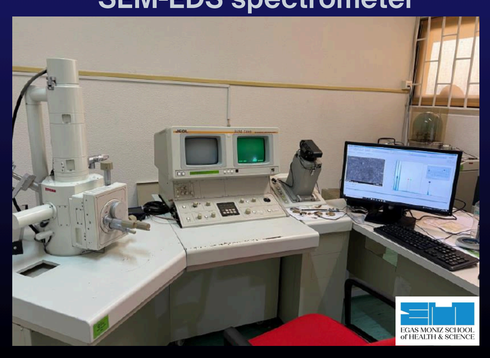


Blue and Black ink samples

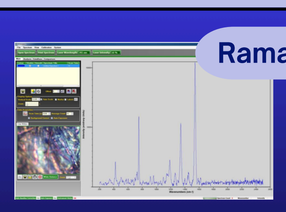
Foster + Freeman ffTA™ Multi-Examination System [4]

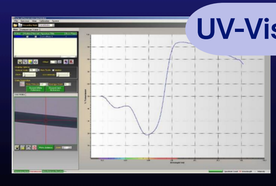


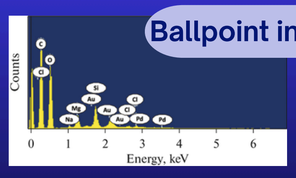
SEM-EDS spectrometer

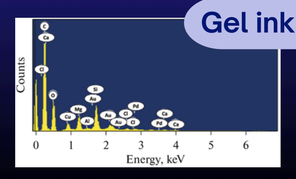


Instrumentation

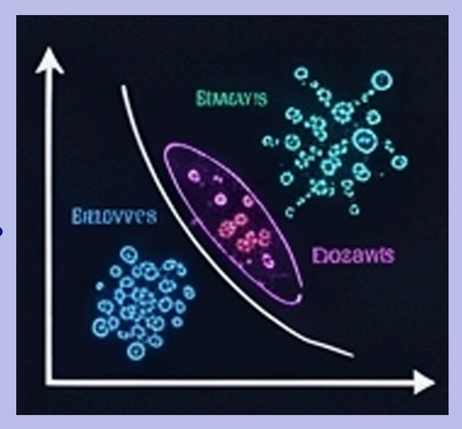








Data



Statistical modeling

INK DISCRIMINATION

EXPECTATIONS

The combination of microspectroscopy and SEM-EDS will represent an innovative approach for characterizing writing inks, enabling the creation of databases and a differentiation improvement.

ACKNOWLEDGMENTS

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REFERENCES

[1] Trejos, T. et al. Spectrochim. Acta Part B, 92 (2014) 9–22. http://dx.doi.org/10.1016/j.sab.2013.11.004.
[2] Kim, J. et al. J. Forensic Sci., 61 (2016) 803-808. https://doi.org/10.1111/1556-4029.13076.
[3] Purba, M. K. et al. J. Anal. Chem., 80 (2025) 887–893. https://doi.org/10.1134/S1061934824603773.
[4] Foster + Freeman ffTA™ Multi-Examination System, https://fosterfreeman.com/ffta/.