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## Modern drawing materials



SESC - Fábrica da Pompéia, São Paulo, 1977-1986, Lina Bo Bardi

In this contribution some modern tracing papers and twenty felt-tip pens used by Lina Bo Bardi (1914, Rome - 1992, São Paulo), an Italian architect and designer, in eleven architectural drawings, currently subjected to conservation treatments, have been investigated. In particular, a multi-technique approach (based on scanning electron microscopy, X-ray fluorescence, infrared spectroscopy, Raman spectroscopy and gas chromatography–mass spectrometry) has been exploited to study their respective chemical compositions.

Tracing papers and felt-tip pens have been used for a wide variety of objects found in modern art and archival collections, such as sketches, drawings, copies, architectural drawings and other technical designs.

Tracing papers are produced by peculiar manufacturing processes to achieve specific chemical and physical properties, such as pH, translucency, gloss and brightness, which, however, can make them particularly susceptible to degradation. Similarly, inks, fillers and media constituting felt-tip pens may be sensitive to light. In addition, to define the optimal conditions for a conservation treatment of these technical designs it is necessary to know the chemical composition of both tracing papers and inks and their sensitivity to specific solvents and adhesives used for cleaning and consolidation procedures.

## Analysis of tracing paper samples

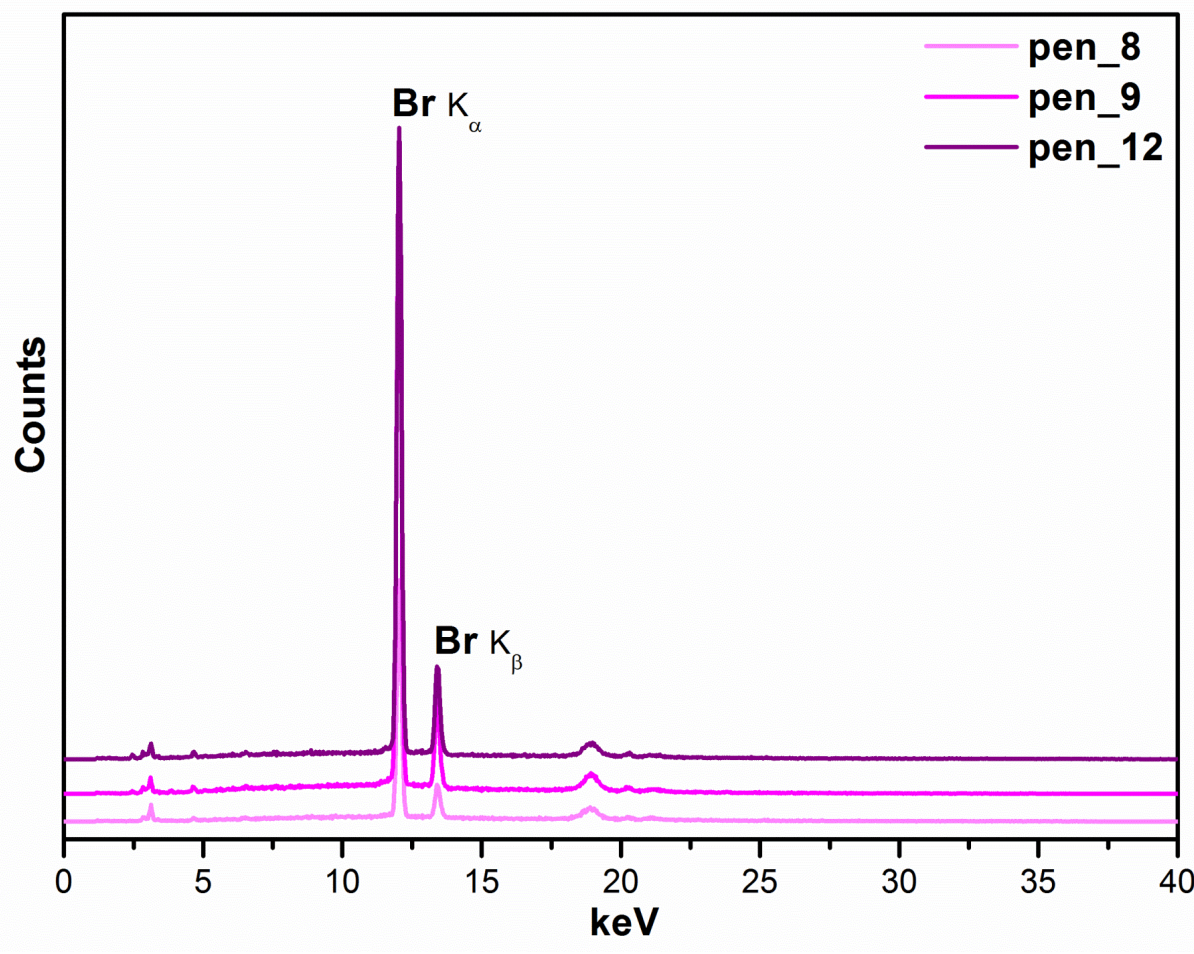
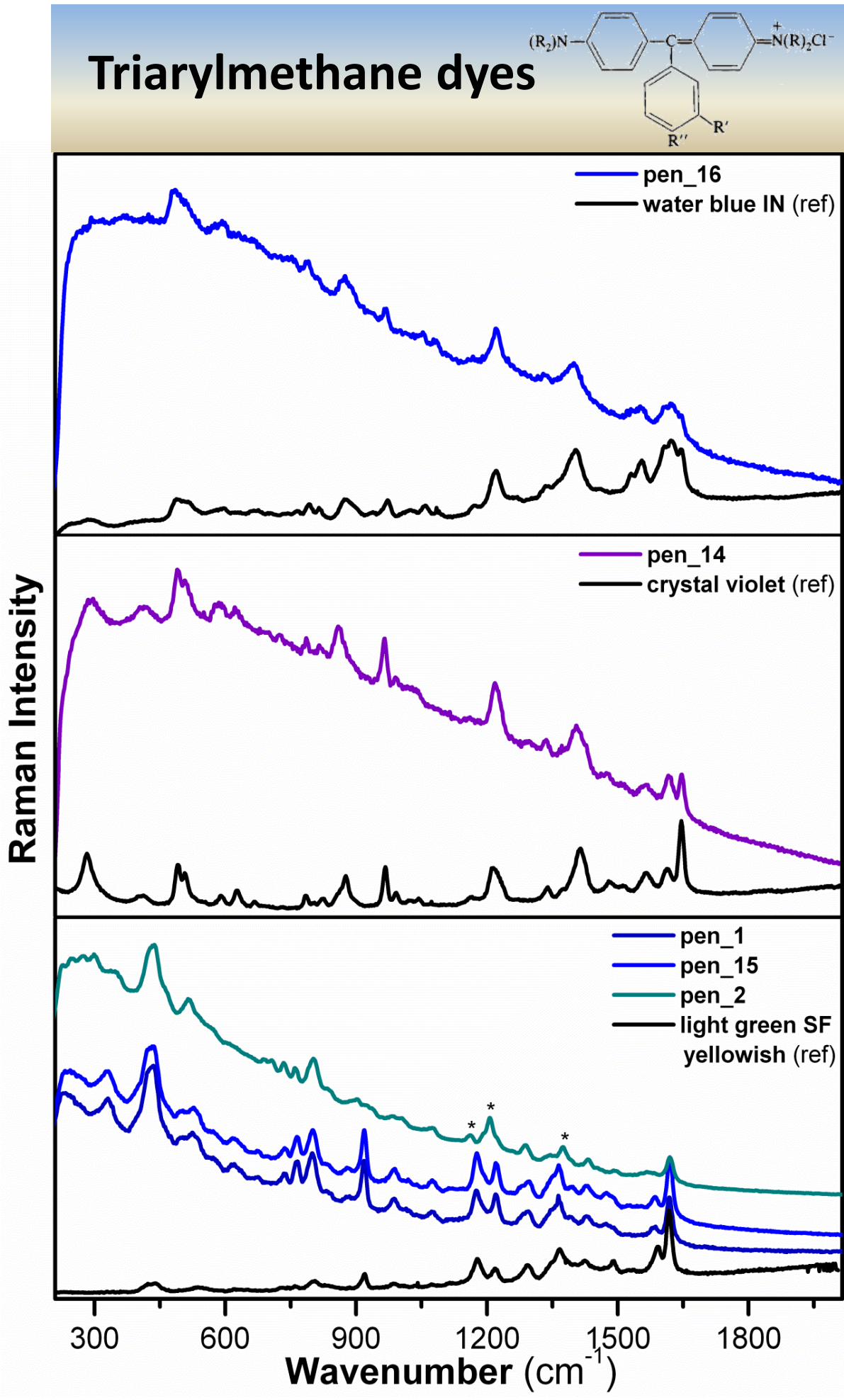
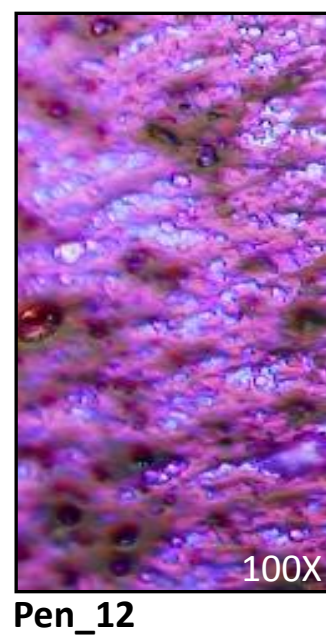
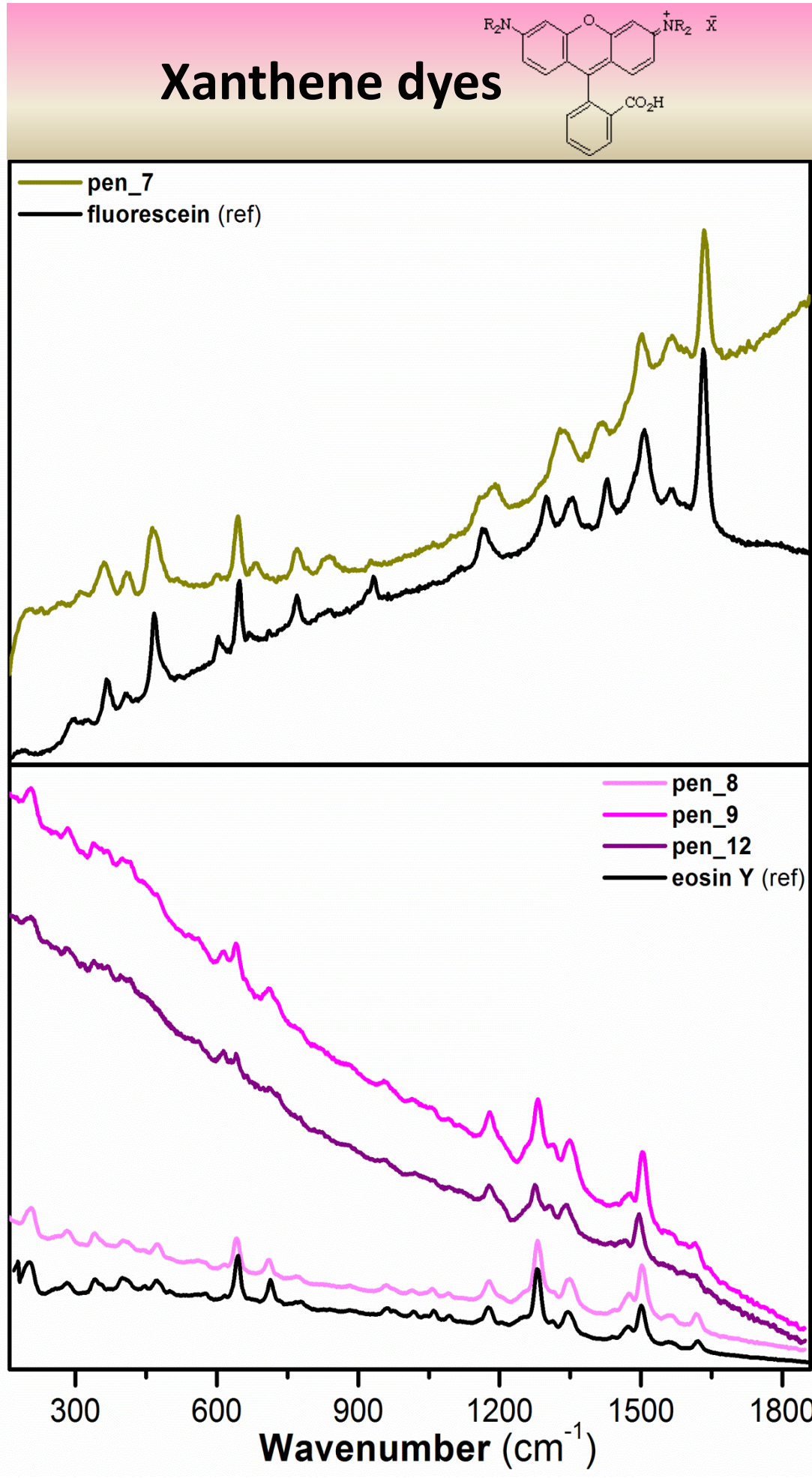
Tracing papers have been analyzed non-invasively by reflection infrared spectroscopies, in all the samples the characteristic signals of cellulose were identified. The paper by Lina Bo Bardi showed the total absence of fillers (such as calcium carbonate, kaolin, etc.) and impregnating materials, indicating the use of a natural cellulose paper. The sample by Le Corbusier, which has a more greenish color respect to those of Lina Bo Bardi, showed bands related to C-H stretching and C=O stretching suggesting the presence of an organic component. Indeed, analysis by chromatography coupled to mass spectrometry (GC-MS), have revealed that Le Corbuseir's tracing paper is impregnated with a mixture of diterpenic resin and linseed oil.

## Characterization of felt-tip pen inks

From the combination of data obtained concerning the elemental composition and the vibrational properties of the twenty felt-tip pens analyzed, it was possible to identify the classes of inks. Specifically, the acquisition of Raman spectra using different excitation laser lines (488, 514 and 785 nm) has permitted three main classes of dyes to be recognize: triarylmethane, xanthenes and azo dyes.

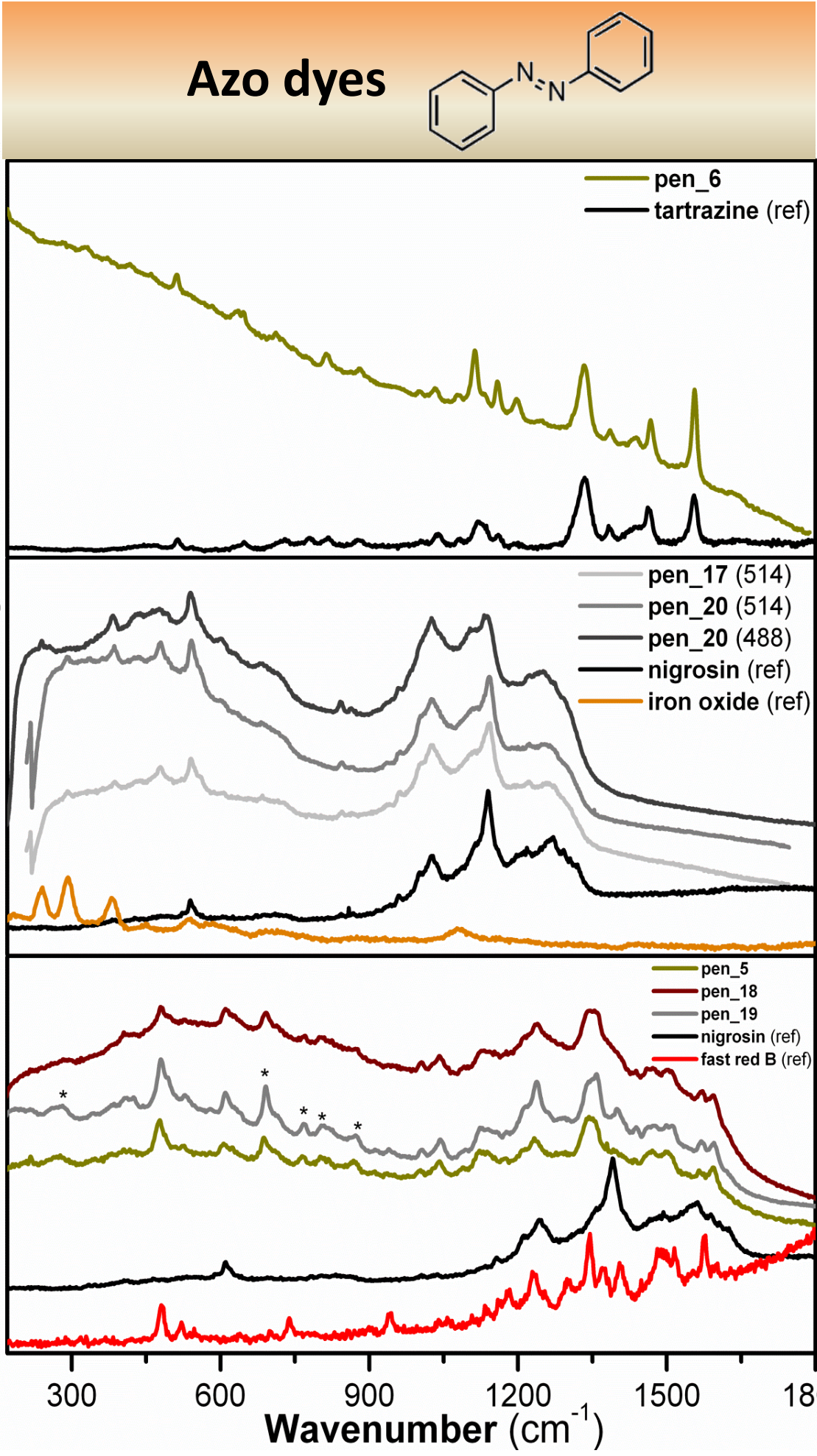
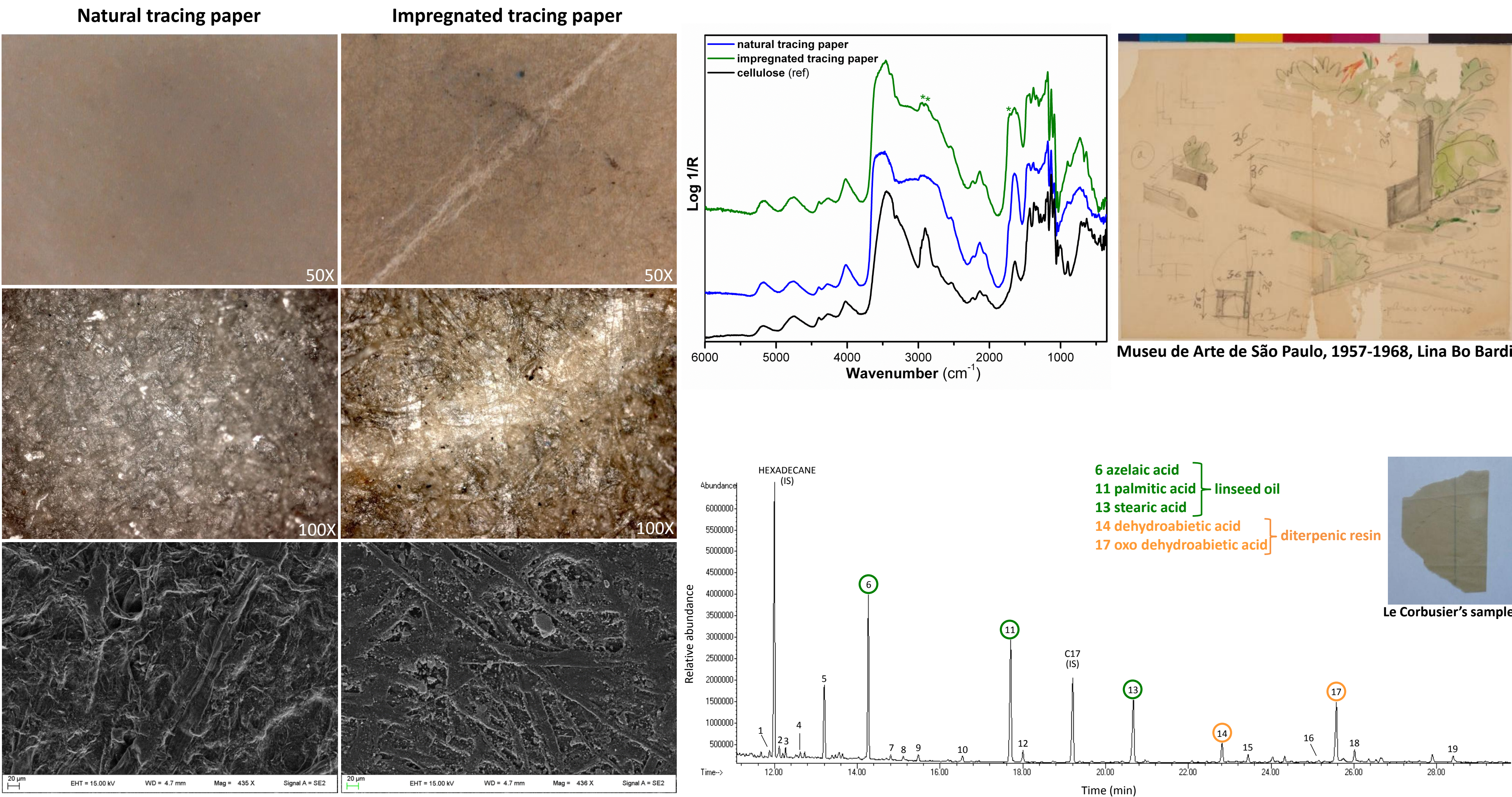
For the first group the dyes identified are: light green SF yellowish (C.I. 42095), water blue IN (C.I. 42780) and crystal violet (C.I. 42555).

The presence of bromine emerged from the XRF data and the Raman spectra acquired for some pink and violet felt-tip pens have allowed eosin Y (CI 45380) to be observed, while in yellow pen\_7 a further xanthene dye, fluorescein (C.I. 45350) has been found.



**References**

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An aniline derivative, nigrosin (C.I. 50420), is present in a mixture either with iron oxide (grey pen\_7 and black pen\_20) or mono-azo dye fast red B (C.I. 16180) in green and brown felt tip-pens. In addition, a different mono-azo dye, tartrazine (C.I. 19140) was identified in yellow pen\_6. For some green (pen\_3 and pen\_4), red (pen\_10 and pen\_11) and purple (pen\_13) felt tip-pens, the identification of the inks is more complicated. In these, the presence of further unknown dyes and/or any degradation product cannot be excluded.

### Conclusions and outlook

The results obtained in this work allow to extend the current little knowledge about the molecular composition of these modern materials and to validate the specificity and sensitivity of non-invasive spectroscopic techniques for these purposes. As for tracing paper, reflection infrared spectroscopy could be used for a first classification of the typology (e.g. natural or impregnated). For the characterization of felt-tip pen inks Raman spectroscopy has revealed the chemical classes of the constituting dyes. A future objective will be to analyze these materials with a specific and selective technique such as the pyrolysis gas chromatography–mass spectrometry (PyGC-MS).