

**XXVII National Spectroscopy
Meeting
XI Iberian Spectroscopy
Conference**

*5 - 8 July 2022
Málaga - Spain*



**XXVII RNE - XI CIE
SPECTROSCOPY**
MÁLAGA • JULY 5th-8th, 2022

BOOK OF ABSTRACTS

<https://www.rne2022.com>

Analysis of two blue triarylmethane dyes by UV-Vis, FT-Raman and SERS spectroscopies

Michela Rampa^a, Santiago Sanchez-Cortes^b, Maria Vega Cañamares^b

^aDepartment of Environmental Biology, Sapienza University of Rome, P.le Aldo Moro 5, Rome, Italy, 00185

^bInstituto de Estructura de la Materia, IEM-CSIC, Serrano 121, 28006, Madrid, Spain

*e-mail michela.rampa@gmail.com

The study of organic colouring materials used in cultural heritage objects provides useful information for dating, authentication, conservation treatments, and art history in general. Synthetic dyes are not as widely studied as natural dyes, since the latter are typically considered of more artistic and historic relevance. However, the study of modern and contemporary art is widely recognized as one of the most difficult and pressing challenges in conservation science. Indeed, the ease in production and employment of these materials was responsible for their huge widespread, accompanied by a lack of scientific knowledge and comprehension of adequate conservation treatments [1].

The aim of the study is to understand the behavior of Basic Blue 26 (Victoria blue B, VBB) and Basic Blue 11 (Victoria blue R, VBR) [2] under different pH conditions using UV-Vis, FT-Raman and SERS spectroscopies. The FT-Raman technique was applied for the Raman characterization of these dyes as they show a great fluorescence emission that prevents the use of other excitation lines. SERS spectroscopy was performed on Ag nanoparticles prepared by reduction by citrate. Various pH values and laser excitation lines were tested in order to find the optimal conditions for the study of the blue synthetic dyes.

At alkaline pH, the UV-Vis spectra show a great shift in the maximum absorption band of VBB, from 616 to 510 nm. However, only an intensity decrease of the main absorption at 611 nm is observed in the case of VBR. This is accordance with the change in the color of the VBB aqueous solution at basic pH.

The SERS spectra of both blue dyes show an intensity decrease as the pH increases, due to the deprotonation of the triarylmethane molecules. Regarding the excitation lines, the position of the absorbance maximum affects the resonance or pre-resonance conditions met by both dyes. Thus, the excitation at 532 nm leads to a pre-resonance conditions of the two species present at acid, neutral and basic pH, while the laser at 633 nm, met resonance conditions only with the VBB species at acid pH. Finally, the 785 nm laser lies far from any absorption maximum, being out of resonance. In the case of VBR, only one absorption maximum is observed in the UV-Vis spectra, meaning that only one is present in solution. Pre-resonance conditions are only met at 532 nm. The differences among the SERS spectra of the dyes at the different pH values were studied by mean of the vibrational analysis obtained from the results obtained by DFT theoretical calculations.

Acknowledgements

Support for this work was provided by Ministerio de Economía, Industria y Competitividad de España (project FIS2017-84318-R) and Comunidad de Madrid/EU (project TOP Heritage). MR acknowledges financial support from Sapienza University of Rome for the thesis abroad.

References

- [1] J. C. Barnett, Synthetic organic dyes, 1856–1901: an introductory literature review of their use and related issues in textile conservation, *Studies in Conservation*, 2007, 52 (sup1), 67.
- [2] B. Doherty, M. Vagnini, K. Dufourmantelle, A. Sgamellotti, B. Brunetti, C. Miliani, *Spectrochim. Acta A* 121 (2014) 292–305.