Micro-Photoluminescence Imaging of intact and degraded Cadmium Yellow paint cross-sections

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UV-visible induced luminescence is one of the first tools employed by conservator and restorers to analyse artworks in a non-destructive and non-invasive way. Recently, due to the development of more quantitative analysis techniques such as multi-spectral imaging spectroscopy and fluorescence lifetime imaging [1], photoluminescence (PL) techniques have been proposed to provide more specific information on the characteristic of the material analysed.

In this field, synchrotron DUV photoluminescence micro-imaging studies have proved to be a useful technique to characterize different types of materials. In particular, the approach has been successfully tested to probe crystalline defects in zinc white pigments, showing that materials homogeneous at macroscale are highly heterogeneous at micro and sub-micro scale [2]. More recently, the technique has been applied to identify the coexistence of two cuprous oxide phases in an ancient amulet and to monitor the processes of metal soap formation in paint films [3,4].

In this work, highly-resolved PL micro-imaging using DUV excitation (SOLEIL synchrotron, DISCO beamline) has been employed to characterize degraded and preserved Cadmium Sulphide paint cross-sections from Pablo Picasso's painting *Femme*.
Previous Time Resolved Photoluminescence (TRPL) spectroscopy analyses of the painting have demonstrated that the degraded CdS paint have a strong and peculiar optical emission from trap states, ascribed to a higher density of surface crystal defects [5]. The use of synchrotron micro-imaging confirms the changing of the PL properties in the degraded paint layer with respect to the preserved one and instead reveals a complex sub-micrometric spatial heterogeneity of the optical emission of the altered CdS paint films.
In the future, other X-ray-based SR studies will be applied to evaluate the crystalline phases present in the paint films and the possible existence of CdS nanocrystal grains [6].

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References

[1] M. Thoury, et al., Analytical chemistry 83.5: 1737-1745 (2011).
[2] L. Bertrand, et al., Analyst 138.16: 4463-4469 (2013).
[3] M. Thoury, et al., Nature communications 7: 13356 (2016).
[4] M. Thoury, et al., Metal Soaps in Art. Springer, Cham, 211-225 (2019).
[5] D. Comelli, et al., Analytical chemistry 91.5: 3421-3428 (2019).
[6] B.D.A. Levin, et al., arXiv preprint, arXiv:1909.01933 (2019).