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Capabilities of MeV SIMS for identification of traditional and modern paint materials –building a database of binders and pigments

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The preservation of works of art for cultural heritage entails the need for sensitive analytical techniques that can aid in the identification of the materials that were originally used by the artist. In the case of paintings, accurate determination of major ingredients of the paint provides invaluable information for restorers and curators and most often encompasses the use of multiple, complementary analytical techniques.

Secondary ion mass spectrometry with MeV primary ions (MeV SIMS) is an accelerator-based nuclear analytical technique that has a high potential in the study of cultural heritage objects due to its high surface sensitivity, the ability to desorb and detect molecular ion species as well as the ability for chemical imaging [1,2]. The benefit of MeV SIMS compared to conventional (keV) SIMS, which is gaining an increasing interest in cultural heritage studies, lies in the sputtering process. By irradiating the sample with an ion beam in the MeV energy range, desorption of intact molecules from the sample surface takes place through electronic sputtering, which leads to significantly higher secondary molecular ion yields, and consequently facilitates the identification of organic components. By coupling it to other ion beam analysis techniques, such as particle-induced x-ray emission (PIXE), imaging and identification of inorganic components is also possible.

The utilization of MeV SIMS for the study of artists'paints is only starting to be recognized and data on this technique is very scarce or unavailable. The need for collecting information on traditional and modern paint materials and investigation of MeV SIMS capabilities in the study of paints is important to benefit from this technique's high potential as well as to couple it with the increasingly popular keV SIMS. In this work an overview of the current studies conducted at Ruđer Bošković Institute is presented, with the focus being on the identification of a wide selection of pigments and binders from commercially available artists'paints, falling into categories of both traditional and modern materials. The aim is to facilitate the accurate identification of major components of the paint mixtures in various case studies, for which several examples are also presented and discussed.

[1] I. Bogdanović Radović et al., Identification and imaging of modern paints using Secondary Ion Mass Spectrometry with MeV ions, Nucl. Instrum. Meth. B 406 (2017) 296–301.
[2] M. Krmpotić et al., Identification of Synthetic Organic Pigments (SOPs) Used in Modern Artist's Paints with Secondary Ion Mass Spectrometry with MeV Ions, Anal. Chem. 92 (2020) 9287–9294.

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