

MeV-SIMS for analysis of modern and contemporary paints - an accelerator-based method for analysis of synthetic organic components

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Secondary Ion Mass Spectrometry with primary ions in the MeV range (MeV-SIMS) was employed as a new accelerator technique for the analysis of synthetic organic pigments (SOPs) and binders in modern and contemporary paints. Due to the so-called “soft ionization” of organic molecules caused by MeV primary ion beam, large intact organic molecules or larger molecular fragments are desorbed from the outermost surface of the sample. This results in MeV-SIMS spectra with molecular peaks of the SOPs and only low number of larger molecular fragments which can be easily used for their identification.

We could show that MeV-SIMS is very suitable, easy and straightforward analytical method especially for exact identification of synthetic organic pigments (SOPs) of different pigment classes in artists paints. Materials tested were pure pigment powders, unaged and artificially aged paint mock-ups as well as several naturally aged samples from painted outdoor sculptures and murals dating from 1970 to 2000. Compared to well-established mass spectrometry and spectroscopic methods used in this field¹, MeV-SIMS offers many advantages: information on molecular level is obtained without sample preparation prior to analysis, identification of SOPs and binder results from same mass spectrum, very small amount of sample is needed for the analysis, the sample is not consumed during measurement, thus still remaining for complementary measurements. Another benefit of the MeV SIMS is that we deal with a surface sensitive method capable for organic materials which is important concerning that material degradation occur mostly in the uppermost layers and this area is usually not accessed by chromatographic methods coupled to MS.

The investigations were performed with the 5 MeV Si⁴⁺ primary ion beam from 1 MV Tandemron² at Rudjer Bosković Institute, Croatia. Secondary ions were detected with linear Time-of-Flight (ToF) spectrometer. Results gained on paint muck-ups and real object samples including molecular imaging will be presented and discussed.

Due to this first application in the area of cultural heritage objects, the MeV-SIMS can be introduced as an additional accelerator-based technique giving access to organic (and inorganic) components on molecular level thus broadening the accelerator application field in sense of supplement the well-established methods in this field such as PIXE, PIGE, and RBS which give only elemental information.

[1] M. P. Colombini, F. Modugno (editors): Organic Mass Spectrometry in Art and Archaeology, Wiley 2009.

[2] T. Tadic, I. Bogdanovic Radovic Z. Siketic, D.D. Cosic, N. Skukan, M. Jaksic, J. Matsuo, Nuclear Instruments and Methods in Physics Research B 332, 2014, 234-237.

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