

Mass spectrometry imaging in art

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Mass spectrometry imaging is a well-established method in bioanalysis.¹⁻³ Its use in artworks' studies is so far limited although it can provide very useful information. It enables to display the distribution of elements and molecules in a sample, to reveal the composition of individual layers. To achieve required image resolution and sensitivity to compounds of interest, different ionization techniques can be selected. The improvement of resolution is an important task.⁴ Although mass spectrometry is a destructive technique, sample consumption can be very low and microinvasive sampling is sufficient then.

Laser can scan the surface and ablate tiny amount that is delivered to inductively coupled plasma mass spectrometry. The elemental composition is determined. Laser ablation (LA) can also provide depth profile as it was demonstrated analyzing the historical watches' material.⁵ The depth profiling of sixteenth-century oil painting revealed the presence of different elements in multilayer samples which supported pigments identification. The damage by LA (100 µm in diameter) was hardly visible.⁶

Secondary ion mass spectrometry can detect elements and small organic ions. The technique was applied to the investigation of Henri Matisse's painting imaging the inorganic (pigments) as well as organic (binders) components of painting cross-sections.⁷ Matrix-assisted laser desorption ionization is another technique useful in mass spectrometry imaging. Using cyanographene as a new matrix we achieved the effective ionization and imaging of oils and fatty acids.

Dicarboxylic acids (the markers of degraded drying oil) were imaged in the cross-sections of wall painting (the earliest Buddhist grottoes in ancient Central Asia)⁸, and azelaic acid in a baroque-era painting⁹ by desorption electrospray. Low-temperature plasma probe was applied to analyze inks on calligraphy.¹⁰

The mass spectrometry imaging of artworks is micro-invasive but offers the characterization of local areas with high selectivity and sensitivity.

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