Radiation for the Study of Paintings: Possibilities and Limitations

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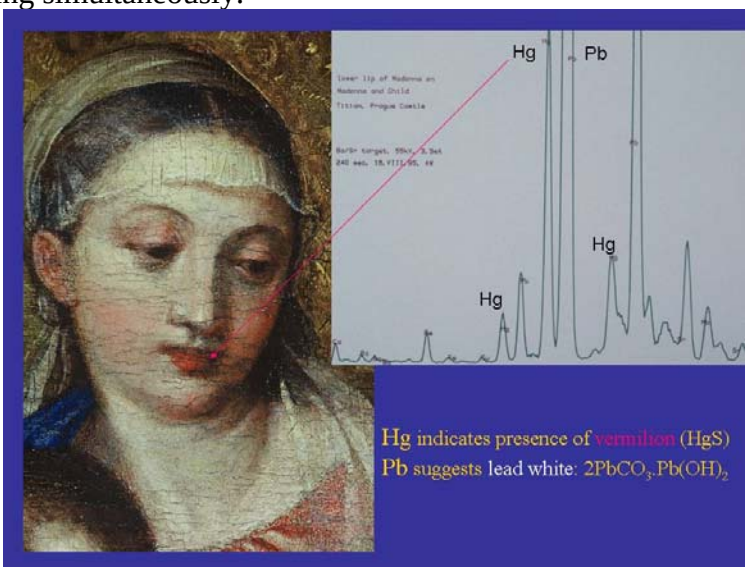
Approaches in the scientific examination of paintings may vary from high-resolution electron microscopy or advanced neutron activation research to old-fashioned micro chemical tests and conventional polarized light microscopy, answering questions that may vary from technical conservation issues to scholarly problems of attribution. The case studies presented deal with paintings of important old masters like Lievens, Titian, de Heem, and Rembrandt. For the examination of such masterpieces non-destructive techniques are usually preferred. Non-sampling techniques can reveal a wealth of information on the support, lead containing pigments, underdrawings and the identity of some pigments.

One of the most important non-sampling techniques is conventional x-radiography. It allows the analyst to literally look through a painting, as the x-ray absorbing compounds such as lead-containing paints, puttied retouchings and nails in the support can be visualized.

Pigments on the surface can be studied by particle induced x-ray emission (PIXE) analysis based on the energies of x-rays emitted upon irradiation with high energy particles.

Similar information can be obtained with x-ray fluorescence (XRF) spectroscopy where the sample is excited by irradiation with x-rays. PIXE and XRF can analyse only a single spot in the painting simultaneously.



Many different measurements are needed to analyse different areas of one painting. Both techniques do not yet allow for satisfactory analysis of larger areas or the whole painting in a spatially resolved manner. They cannot be classified as imaging techniques. This is a serious disadvantage since the chemical properties of adjacent areas can be completely different. Painting materials in traditional paints contain many impurities, resulting in difficulties in the interpretation of spectra. The interpretations are further complicated because in the techniques of the old masters, generally several paint layers were applied for larger coloured areas, for smaller details, shadow regions and highlights. In the study of such multi-layered paint systems it is impossible to physically separate these thin (between 1 and 100 μm thick) and inhomogeneous layers and analyse them individually.

Synchrotron radiation can be used to overcome some of the problems encountered with conventional methods. A few possible solutions to address some important questions in technical art history are discussed.