

HORIBA JOBIN YVON

New Technology for X-ray Microanalysis

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With the recently introduced capability to focus x-rays to spots as small as 10mm new instrumentation has been developed for X-ray fluorescence microanalysis with not requirement for vacuum. The XGT-5000 from Horiba Jobin Yvon provides both X-ray transmission and fluorescence images; it is equipped with 2 out of 3 available capillaries for fluorescence excitation (10 mm, 100 mm, and 1.2 mm). X-ray fluorescence (XRF) is used for the detection of elements between Na and U. Such equipment has been shown to be useful for the study of catalysts, objects of art, corrosion and other oxides, geological/mineral samples, histological samples, and pharmaceuticals.

In this note the XGT-5000 was used to analyze a figure from an ancient Nepalese manuscript, to determine what types of pigments were used and how they were applied to obtain the color. Because X-rays are able to penetrate deep inside paper those pigments used for the undercoating could be successfully identified in addition to those on the surface.

Figure 1 shows the X-ray transmission image on the left, and a RGB composite image on the right, with red being Au, green is

Cu, and blue is Pb. [Courtesy of: Mr. Kato, Mr. Konan, Classical Manuscripts Digital Archive Study Center, Owned by Ryukoku University Library]

A more complete analysis is shown Figure 2 where each pigment is identified by matching the indicated number with the row in the table.

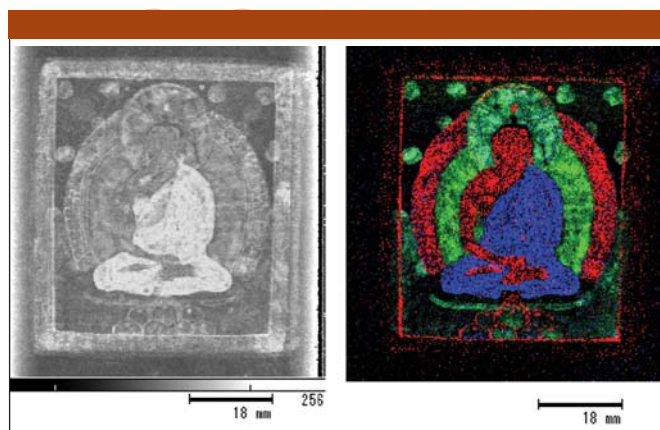


Figure 1.

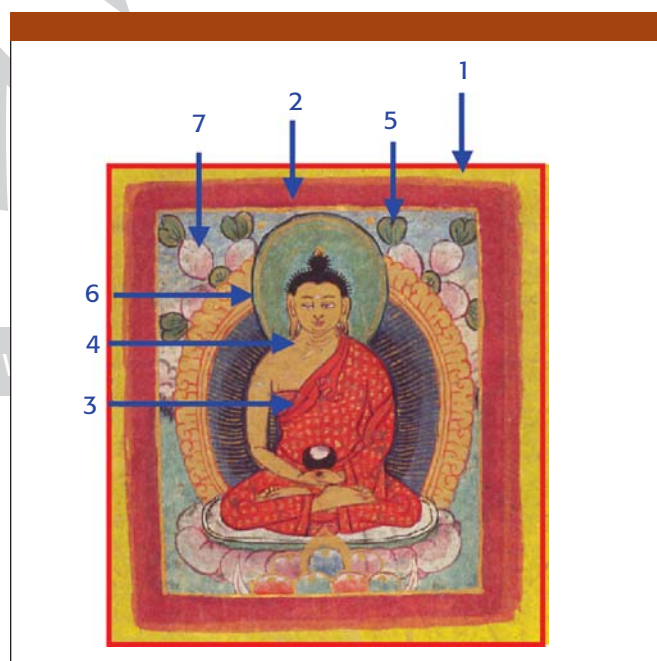


Figure 2.

| Analysis points | Color | Detection elements | Estimated pigments, etc. |
|-------------------------------|--------------------------|--------------------|--|
| 1 The groundwork of the whole | Yellow | Pb, Cr | PbCrO ₄ |
| 2 Frame | Vermillion | Hg | Vermillion mercury (HgS) |
| 3. Surplice | Orange | Pb | Diachylon (Pb ₃ O ₄) |
| 4 Skin | Gold | Au | Gold leaf was affixed |
| 5. Leaf | Green | Cu | Carbonate (Cu CO ₃ /Cu(OH) ₂) |
| 6. Holy flame | Blue | Cu | Basic copper 2Cu CO ₃ /Cu(OH) ₂ |
| 7. Petal | White and pink gradation | Ca, Mg, Si, Pb, Cr | Mixed color of rubine toner (Ca O, Ca CO ₃), talc Mg ₃ (Si ₄ O ₁₀)(OH) ₂ Pb Cr O ₄ |

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