Conserve O Gram

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The Use Of Ultraviolet Induced Visible-Fluorescence In The Examination Of Museum Objects, Part II

Fluorescence Characteristics of Art and Artifacts

Paintings: Long-wave UV examination can reveal the presence of natural resin varnish layers, which fluoresce and appear as a yellow-green haze over the surface of the painting. Some other old varnishes, especially those that contain linseed oil, may appear as a bluish haze. If the painting has been treated in the past, the appearance of the fluorescence will often indicate this. For example, if the varnish has been selectively removed from certain areas of the painting, the overlying fluorescent haze will be missing from these areas. Later areas of retouching usually fluoresce much less brightly than the original oil paint and varnish (or in some cases, do not fluoresce at all) and thus often appear as dark or black spots on the painting. Areas of retouching may occur over early varnish layers and under later ones, and in those cases, may have a fluorescent haze over them. When examining oil paintings, the oil paint medium generally fluoresces quite brightly and thus the image of the painting is easily visible. A small number of pigments (the coloring agent mixed into the oil medium) also fluoresce, some with distinctly characteristic colors that can give an indication of the identity of the pigment (e.g., zinc white fluoresces a bright lemony yellow).

A lack of fluorescence does not necessarily indicate the absence of a varnish. Superficial dirt and grime may obscure the fluorescence significantly. Also, many synthetic resins do not fluoresce at all. Most acrylic paints, unlike oil paints, do not fluoresce either.
Ceramics and Glass: Ultraviolet is most useful in the examination of ceramics and glass in determining the presence of previous repairs. Many adhesives used to reconstruct broken ceramics fluoresce. Often, the fluorescence of these adhesives becomes more pronounced as they age. Many adhesives used in repairs may appear under long-wave UV illumination as bright fluorescent lines along the joins between broken sections that contrast with the dark, non-fluorescing areas of the ceramic. Examples of such adhesives (and their usual fluorescence under long-wave UV) are: epoxies (bright yellowish white); poly(vinyl acetate), e.g., Elmer’s Glue® (bluish milky fluorescence); shellac (bright orange); cellulose acetate, e.g., UHU® (milky white fluorescence); and cellulose nitrate, e.g., DUCO® (greenish yellow). However, some adhesives do not fluoresce. One example is Acryloid B72® resin, which is commonly used by conservators to repair ceramics. Therefore, it is important to remember that not all repairs may be readily apparent under ultraviolet illumination.

UV examination can be helpful in identifying replaced sections (or fills) in ceramics, which often fluoresce under long-wave UV. The fills can then be compared to the dark, non-fluorescing areas of the original.

Hard-paste porcelain can often be identified by its dim pink fluorescence in short-wave UV compared to the milky white color of soft-paste porcelain. Lead glass exhibits little fluorescence under long-wave UV, but stands out as a dramatic icy blue under short-wave UV. Uranium glass fluoresces a bright yellow/green color under long-wave UV.

Stone: Freshly cut marble, limestone, and alabaster do not fluoresce significantly. As these stones age, their surfaces take on a patina that may appear mottled white under long-wave UV illumination. This characteristic often makes it possible to distinguish old marble, limestone, and alabaster from that which is newer or has been artificially aged or patinated. The technique is less useful with other types of stone, such as granite and sandstone, which do not age in the same way due to the hardness of their constituent minerals.

As in the case of ceramics and glass, UV examination of stone objects can help to identify previous restoration. Adhesives often fluoresce and can indicate repairs. Areas filled in with different materials, such as plaster or wax, will fluoresce differently than the stone surface.

Ivory and Bone: Ivory and bone fluoresce similarly to one another. Under long-wave UV, they have bright whitish fluorescence when new and develop a subdued, mottled, yellow fluorescence as they age. Previous repairs on aged ivory and bone are distinguishable in the same manner as those on ceramics, glass, and stone objects.

Metals: In general, metals do not fluoresce. However, materials applied to the surface of metals, such as wax or resin, may fluoresce. Some waxes may fluoresce bright white under long-wave UV illumination. Natural resins may fluoresce green, yellowish, or milky-gray. Synthetic resins, which are often used to coat objects and protect them from corrosion, do not always fluoresce, so a lack of fluorescence does not necessarily mean the object is not coated. As with other materials, paints and glazes applied to the surface of metal objects in order to artificially age them can often be detected using UV light.

Paper and Parchment: Modern papers, which usually have optical brighteners added to them and fluoresce bright bluish white under long-wave UV light, are often distinguishable from older papers. Older papers generally appear white, yellow, or gray.

Mold on paper and parchment and tide lines that are not apparent under visible light can often be detected using long-wave UV light. Both mold and tide lines usually appear as a faint yellow fluorescence.

As with other kinds of objects, old repairs on paper and parchment are often apparent when viewed under UV radiation. Areas of the paper that have been replaced and any reinforcements added to the paper, such as linings, will usually appear different from the original.

Textiles: Old textiles can sometimes be distinguished from newer textiles in a manner similar to paper objects. Modern threads are often treated with optical brighteners and fluoresce brightly under long-wave UV. Repairs on textiles can sometimes be identified by comparing brightly fluorescing areas with older areas that have little or no fluorescence. However, use caution. UV examination of textiles can be confusing. Old textiles washed in modern detergents, which have optical brighteners added to them, will also fluoresce.

Wood: Although a few species of wood show strong fluorescence under long-wave UV (e.g., sumac), most fresh cut woods have little fluorescence. However, wood takes on a patina as it ages and over time will often fluoresce in mottled tones under long-wave UV. Repairs and artificial patination, which will generally not fluoresce, can sometimes be distinguished by comparing them to the fluorescence of old wood. Fluorescent coatings and varnish on wood can also be detected. A common wood coating, shellac, fluoresces a very distinctive bright orange under long-wave UV.

Mineral Specimens: A large number of gem and mineral specimens fluoresce, many under short-wave UV. Fluorescence is commonly used to categorize these materials, their origin, and their constituent materials. Minerals that fluoresce under short-wave UV include scheelite, which generally appears pale blue, and scapolite, which usually fluoresces a strong orange-yellow. More information can be obtained in the many readily available references classifying gems and minerals.

Choosing a UV Lamp

When choosing a UV lamp, consider a number of factors. Determine the objects most likely to be examined, and decide on a long-wave, a short-wave, or a combination lamp accordingly. Purchase a plug-in or portable lamp according to your needs. Portable lamps are convenient for those working in areas where outlets may not be available, but may require frequent recharging or replacement of batteries.

Another issue to consider is the lamp type. There are two different lamp types: high pressure mercury vapor bulb and fluorescent tube (or low pressure mercury tube). Fluorescent tube units are readily available in a wide variety of models, many of which are inexpensive, and/or battery powered and portable. More costly mercury vapor bulb lamps produce a very high intensity emission of UV radiation but require a heavy transformer that comes with the lamp. While they can be hand-held, they generally are a bit more cumbersome than fluorescent tube units. Also, there are a limited number of models available as battery powered, portable units. In addition, they produce more heat than fluorescent tube units and thus should not be held in close proximity to the surface of an artifact for any extended period of time. However, because of their high UV output, the fluorescence they produce is much brighter and easier to observe than that produced by most fluorescent tube units. They also have better filtration than most fluorescent tubes and thus leak less visible light onto the subject, further improving the visibility of the fluorescence.

Lamp intensity should also be taken into account. The intensity of UV radiation is measured in microwatts per square centimeter ($\mu W/cm^2$). Manufacturers generally list the intensity of fluorescent tube units as measured with the lamp held six inches away from the surface being examined. The intensity of most available fluorescent tube lamps ranges from 300 $\mu W/cm^2$ to around 900 $\mu W/cm^2$. Ratings for high-pressure mercury lamps are usually measured with the lamp held fifteen inches away from the surface. Intensities for these lamps range from 1200 $\mu W/cm^2$ to 6000 $\mu W/cm^2$. For general purpose examination, any lamp within these ranges should be satisfactory, though lamps with intensities at the higher end will produce brighter, more easily observable fluorescence.

A number of additional features are also available. Some models include a visible light bulb, and others have a magnifier. As with any purchase, discuss your needs and various options with vendors to determine the best possible lamp for your needs.

Remember to include eye protection when purchasing a UV lamp. Long-term exposure to UV radiation can lead to serious vision problems. (See *Conserve O Gram* 1/9, The Use of Ultraviolet Induced Visible-Fluorescence in the Examination of Museum Objects, Part I, for more information.)

Suppliers of UV Lamps and UV Protective Glasses

Spectronics Corporation
956 Brush Hollow Road
P.O. Box 483
Westbury, NY 11590
(800) 274-8888
www.spectroline.com
UVP, Inc.
2066 W. 11th Street
Upland, CA 91786
(909) 946-3197
www.uvp.com

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