

Transparent Finishes on Furniture and Fluorescent Microscopy

Greg Landrey, Winterthur Museum, Winterthur DE.

Micro-chemical characterization of binding media and transparent films has not, to date, been commonly used in the examination of surface coatings on furniture. We will be looking at several case studies showing how fluorescent microscopy can help us better understand existing paint or varnish layers and how decisions on conserving these coatings can be made with greater precision.

Eberhard Becker, a researcher and writer on fluorescent microscopy wrote and I quote: “The extraordinary importance of fluorescent microscopy to research and routine in the various practical fields...is fully accepted. The number of those who use this modern microscopic technique is continuously increasing.”¹

We will first look at the energy phenomena of fluorescence.

Luminescence is light emission based on previous irradiation with light, not the heat of the substance. This can be triggered by a chemical reaction.

Phosphorescence is a specific form of luminescence that does not manifest itself as immediately but after the excitation of light irradiation. It is a type of afterglow.

Fluorescence is also a form of luminescence that is observed as immediate light energy at the time of light irradiation. It is a result of energy released from electron jumps as the electron returns to its unexcited state.

Primary fluorescence, or auto fluorescence, is a result of excitation by short wave radiation without the use of any fluorochrome.

Secondary fluorescence is caused by fluorochromes which make non-fluorescent materials fluoresce. Specific fluorochromes are used to identify specific substances by reacting with a particular functional group causing the compound to fluoresce.

The phenomena of fluorescence has been summed up by Becker, and I quote “...It is the purpose of fluorescence microscopy to render certain well-defined object structures visible...”²

The microscope I have been using is a Nikon “Labophot” with incident light. It uses an ultra-high pressure mercury 100 watt lamp. It is the electrical current going through the mercury gas that results in the excitation light.

The excitation filter (405 nm) cuts out unnecessary wavelengths. A dichroic mirror is used as an interference filter reflecting down specific wavelengths and transmitting others. The barrier filter (460 nm) cuts out excitation light not absorbed by the specimen. This filter also serves to keep possible damaging light from reaching the eye.

The slides that you will see were photographed on a Nikon HFX automatic micro photographic unit. The fluorochromes we are using on the projects seen here include Rhodamine B, Antimony Pentachloride, Lissamine and Rhodamine B for metal ions.³

Rhodamine B - Reacts with available oxygen and double bonds in oils. Fluoresces orange-red.

Antimony Pentachloride - Fluoresces blue in the presence of terpenes in natural resin varnishes.

Lissamine - Fluoresces orange-red in the presence of protein.

Rhodamine B for metal ions - Fluoresces dark or orange in the presence of lead, iron and silver.

Case Study A - Side chair, New York, ca. 1800 (57.838.4). On the macro level, this chair appears to have one or two layers of finish. However, the cross sections indicate as many as six individual layers of resins, oils or colorants. The lowest layer, fluorescing a salmon color may well be shellac. Fluorescent microscopy has revealed a highly complex finish structure that otherwise could not be known.

This cross section was stained with Rhodamine B rendering positive secondary fluorescence in the middle layer indicating the presence of oil.

Case Study B - Chest on chest, Philadelphia, ca. 1765 (60.1056). The slide seen here has been stained with Rhodamine B. Three zones are visible, each having a distinctive characteristic.

The layer in the wood appears “granular” in nature perhaps containing impurities or colorants. This zone has stained positive for oil. It is this stratum which is likely to be the finish first applied to this piece.

The middle layer is remarkably homogeneous. It has stained negative for Rhodamine B suggesting that it is a non-oil natural resin.

The top, thin layer has stained a bright red suggesting a high oil content. Dirt and grime can also be observed in this zone.

The above information not only gives us an idea of the finish history, but also suggests treatment possibilities.

The top layer proved to be the disfiguring, dark, sticky layer which we wished to remove. This oil layer can be removed safely with an enzyme (lipase) without affecting the non-oil middle layer.

The theoretical and practical proved to be consistent as the treatment plan, based on the microscopy results, worked as expected. Finish technicians Scott Friedgen-Veitch and Nancy Reinhold will continue microscopy on this chest on chest and carry out the rest of the treatment.

Additional case studies can be found in the 1987 AIC Preprints, pp. 168-202.

Fluorescent microscopy is a tool that should not be shied away from. It is both affordable and can be

learned without an inordinate amount of training.

Understanding the nature and inter-relationship of surface coating layers, what the original media or films may have been and what materials are present is critical to knowing how to care for an object.

It is the paint or finish that visually represents a wooden object. We can never know too much about a surface coating when deciding on a treatment or making technical comments on its make-up.

Fluorescent microscopy, using specific dyes does not tell us all but it can give us more information about an object's outer skin than we would otherwise have.

End Notes

¹Eberhard Becker. Fluorescence Microscopy. West Germany: Ernst Leitz Wetzlar GMBH, 1985, p. 2.

²Ibid.

³For more information, see: Richard Wolbers and Gregory Landrey. "The Use of Direct Reactive Fluorescent Dyes for the Characterization of Binding Media in Cross Sectional Examinations," AIC Preprints, Washington, D.C., 1987, pp. 168-202.