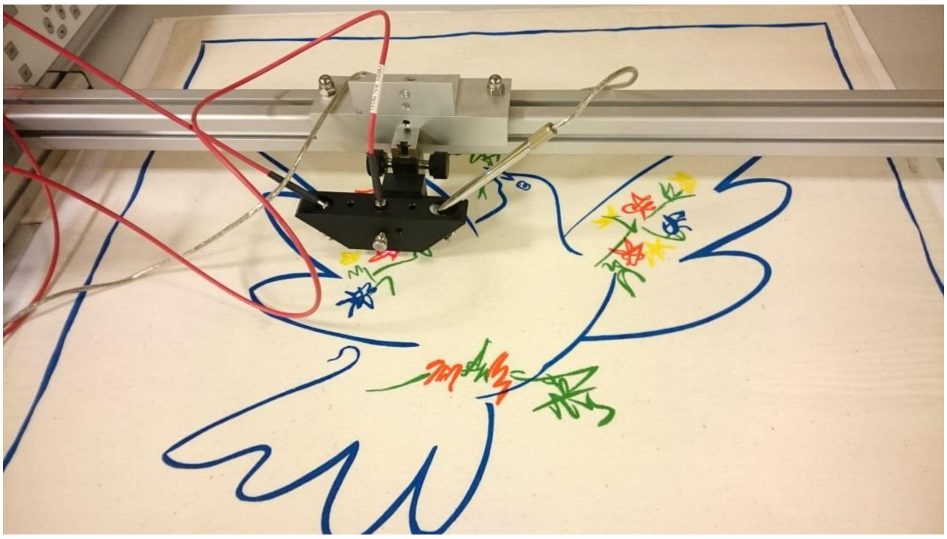
Microfading Workshop & User Meeting

Book of Abstracts



Microfading-testing at Rathgen-Forschungslabor on a cotton fabric
of the Kunstbibliothek (Inv. Nr.: 2008,57/1)
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Organized by Rathgen-Forschungslabor,
Staatliche Museen zu Berlin

7. - 8. November 2016
Berlin

Rathgen-Forschungslabor
Staatliche Museen zu Berlin

Foreword

Many museums increased their attention for the preventive conservation of object lighting in their facilities. The selection and positioning of the illuminants is only one aspect among many, which must be taken into account in the case of expert and successful exhibition lighting. The demands for a sustainable preservation of the color impression of the exhibited objects on the one hand and an appealing design presentation on the other hand must be carefully weighed.

Spectral intensity distributions, color temperature, color reproduction quality and damage potential of the light sources are compared more intensively and discussed more intensively than before.

The light sensitivity of the object is a central point in this context. Research on this issue has already been carried out since the 19^{th} century. Some recent scientific workshops discussed this question, namely in the framework of ICOM-CC. The European Committee for Standardization and the International Commission on Illumination have published documents, which provide first indications for the appropriate lighting durations and intensities for light-sensitive material classes in museums. However, the subject has not yet been covered in its entire breadth and depth and has not found a satisfactory solution for all museum items.

An appropriate method allowing the objective determination of the light sensitivity of an object is microfading testing (MFT). From the MFT one can establish a connection between 'light quantity' (exposure) and fading of the object, i.e. the light fastness of the materials. Therefore, the test result represents a differentiated and well-founded decision-making basis with regard to the possible lighting or exhibition duration of an object.

The *Rathgen-Forschungslabor* (RF), the research and service laboratory of the *Staatliche Museen zu Berlin-Preußischer Kulturbesitz* (National Museums in Berlin-Prussian Heritage Foundation) was the first institution in Germany to offer expertise in the field of MFT and thus museum lighting with investigations into the potential damage and the color rendering quality of luminaires (Web link: www.smb.museum/fileadmin/website/Institute/Rathgen-Forschungslabor/Liste_Leuchtmittel.pdf). It has also established a protocol for evaluation the damage potential of light sources to be used on different kinds of museum items. A second German institution who is today equipped with MFT is the *Hochschule für Bildende Künste* (HfBK) in Dresden. In order to disseminate the current knowledge, the advances, but also the challenges and limits of the application of MFT and exhibition lighting in general, a workshop and user-meeting intended to inform interested colleagues appeared necessary.

Besides presentations of the equipment and research of the RF and the HfBK, nine internationally renowned scientists from leading museums and conservation sciences are invited to show current research and to provide information on good practices on lighting policy in other institutions.

We hope that this event will results in many fruitful scientific discussions, will supply valuable information for a well-founded decision-making process on lighting and exhibition policy and will, as a resonance, stimulate the creation of an active international research and user group interested in developing research in the field of preventive preservation linked to museum lightening.

Berlin, the 4th of November 2016

Ina Reiche

Director of the Rathgen-Forschungslabor, Staatliche Museen zu Berlin-Preußischer Kulturbesitz

Content

AK Archäometrie in der GDCh

Program – Workshop

8:30 Registration

9:00 Welcome

Dr. habil. Ina Reiche, Director Rathgen-Forschungslabor

Session 1 - Introduction to context

9:15 An Introduction to artificial light in museums

Boris Pretzel, Victoria & Albert Museum, UK

9:45 Chemical aspects of color changes in aging 15th to 20th C. paintings

Jaap Boon, JAAP Enterprise, NL

10:15 How we perceive light and how it affects the objects

Stefan Röhrs, Rathgen-Forschungslabor, SMB, D

11:30 Coffee break

Session 2 - Introduction to technique

11:15 Braking the rules

Bruce Ford, freelance Art & Archival, AUS

– video and discussion via Skype –

11:45 An introduction to microfade testing (MFT): From a 0.3 mm high intensity light spot to specific display lighting recommendations for museum collections

Julio Del Hoyo-Meléndez, The National Museum Krakow, PL

12:15 Lunch break (on own expenses)

Program - Workshop

Session 3 - Interpretation and implementationy

13:45 Influence of lighting environment on MFT interpretation: adjusting the interpretation of MFT results when considering exhibition conditions such as spectral shape and overall luminosity

Pablo Londero, Yale University, US

14:15 Setting a preservation target and using the microfading test results in order to implementing lighting policy for vulnerable artworks

Christel Pesme, Independent researcher, CH

14:45 Light damage: perception, risk and mitigation

Boris Pretzel, Victoria & Albert Museum, UK

Session 4 - Practical presentation

15:15 With or without UV – examples of microfading with near UV

Thomas Prestel, Hochschule für Bildende Künste Dresden, D

15:30 Coffee break

15:45 Current case studies from the collections of the National Museums in Berlin

Ina Reiche, Rathgen-Forschungslabor, SMB, D

16:00 Material tests by micro fading

Thomas Prestel, Hochschule für Bildende Künste Dresden, D

Carlos Morales-Merino, Rathgen-Forschungslabor, SMB, D

16:45 Panel discussion

Boris Pretzel, Victoria & Albert Museum, UK

Pablo Londero, Yale University, US

Julio Del Hoyo-Meléndez, The National Museum Krakow, PL

17:15 End of workshop

Program – User Meeting

8:30 Registration

9:00 Summary and conclusion on workshop
Stefan Röhrs

9:15 Challenging cases of micro fading applications
Carlos Morales-Merino

9:35 Limitations and concerns associated with microfade testing (MFT)
Julio Del Hoyo-Meléndez

9:55 Fading behavior of blue wool #1 over four decades of lighting intensity
Pablo Londero

10:15 Poster presentations
Determination of light fastness of bookbinding fabrics using microfadometer system in The National library of Czech Republic
Petra Vávrová

Colour monitoring and microfading in Old Masters Picture Gallery, Dresden
Thomas Prestel

10:25 Coffee break

11:05 A comparison of the results from microfading and conventional light ageing tests
Capucine Korenberg

11:25 Alternative perspectives on blue-wool-standards in microfading
Thomas Prestel

11:45 Color change, causes, perception and interpretation. How to interpret the color change (ΔE) induced by MFT?
Christel Pesme, Claire Gervais

12:05 Discussion

12:35 End of the meeting

Session 1 - Introduction to context

An Introduction to artificial light in museums

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This lecture concerns the history of the use of light in Museums, focusing on the development of modern light sources, color reproduction, and lighting. With the example of the Victoria and Albert Museum in London (the first museum in the world with galleries equipped with gas lamps to allow late opening), we explore the changes in attitudes and possibilities over time, starting with the early use of daylight and going through to the latest, technically highly sophisticated, LED Light sources, the so-called „Smart Lights“. In the course of the lecture, threads on topics of light sensitivity, energy consumption and sustainability will be woven together.

Chemical aspects of color changes in aging 15th to 20th century paintings

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The talk reviews work performed by my team in the last 20 years. Various forms of chemical reactivity in aging paintings have a large impact on color and contrast. Tiny paint samples from paintings investigated in cross section by imaging micro-spectroscopy and mass spectrometric microscopy provide insight into the changes in chemical composition.

Materials in the paint buildup migrate and interact. Changes in contrast are often due to the formation of lead soaps at the expense of the light-reflecting lead white crystals. This reactivity may also cause darkening of the painting resulting in a very poor appearance and readability. The 15th and 16th century lead tin yellow pigment is strongly destabilized by reactions with fatty acids.
Smalt a 17th century blue glass used in paintings is sensitive to acid from the oil binding medium leading to color loss due to loss of potassium that changes the cobalt coordination chemistry. Emerald green (a 19th century copper arsenate coordination compound) is sensitive to reactivity with fatty acids leading to copper soaps and copper oxides causing the green to turn into a brown color. A primary color like the semiconductor pigment vermilion

becomes light sensitive due to chlorides that cause a catalytic process leading to blackening and grey mercury chloride crusts. Apart from the change in chemistry the layer structure and buildup of the paints is playing a vital role in the present appearance. Loss of zinc white from paints in 19th and 20th century paintings leads to darkening and color changes. Overlying or underlying paint layers play a role.

Organic colors can be sensitive to degradation often because of the chemical environment of paints. My team explored ways to investigate light induced degradation of indigo, oils and terpenoids in liquids using mass spectrometry. The naphtol reds in the Seagram paintings (Tate, London) by Rothko are destabilized by ultramarine and oxygen when exposed to light as could be deduced from the oxidation state of dammar used as binding medium. Experimentally, the degradation of naphtol red could be shown in liquid phase experiments investigated by mass spectrometry. The role of light in the process is furthermore deduced from comparative work of samples from the painting. These approaches are useful for chemical understanding of fading.

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Light sources: relative light damage potential

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Light can damage many collection items in an irreversible way. However, light is needed to exhibit objects in the museum, as without light visitors cannot admire the objects on display.
The human eye has a spectral sensitivity for wavelength from 380 nm to 780 nm. It is given by the V (lambda) curve. Objects perceive light in a different way than the human eye. For the object the energy content of the absorbed radiation is crucial. The spectral power distribution curves of the artificial light sources differ depending mainly on the type of light source; e.g. halogen, fluorescence or LED. As a result, the light of two light sources with different spectral power distribution curves adjusted to the same lux value can differ in the energy content.
In empirical tests the so called action spectrum had been determined which describes the damaging effect of the light depending on the wavelength. The calculation of the relative light damage potential used the action spectrum and allows estimating the damage potential of the light source. It allows comparing artificial light sources by a simple number with respect to a reference light source. Considering the relative light damage potential can further reduce the impact on light on objects. Depending on the light source, a reduction of damage potential by a factor of about 20% can be accomplished.

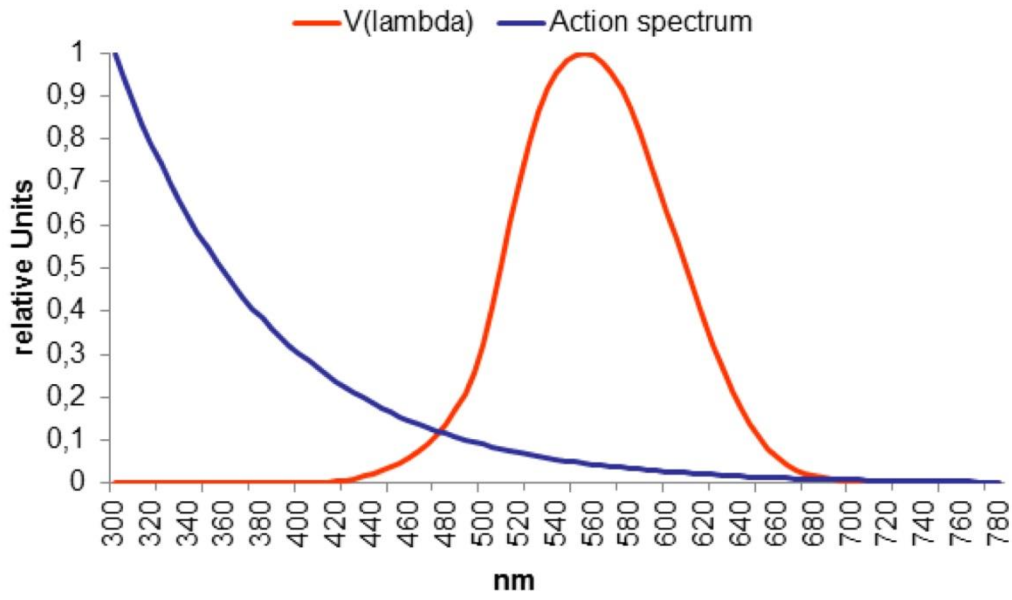

Fig. 1: Comparison of relative luminous effciency function of the human eye V (lambda) compared to the relative action spectrum.

Session 2 - Introduction to technique

A scientific and cultural approach to managing light exposure

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In late 2007 the Deputy Conservation Manager Nicki Smith and I were asked to review the National Museum of Australia's (NMA) lighting guidelines [1]. The Museum's Operations Manager was seriously concerned about the cost of light-driven object replacements designed to limit fading, particularly in permanent exhibitions. According to an order of magnitude estimate, each replacement cost $1000 taking into account conservation, curatorial and exhibition staff time and other resources, amounting to hundreds of thousands of dollars each year that the museum could ill afford to spend.

At that time the NMA's guidelines closely followed the Victoria and Albert Museum's (V&A) lighting policy [2], which imposed a blanket restriction of two years/decade on the display of objects (containing colourants) less lightfast than ISO Blue Wool Fading Standard 4 (BW4). This was regarded as highly light-sensitive for museum purposes. The 1:5 ratio of display to dark storage was predicated on an "average" lightfastness of BW2 and a desire to limit fading to one Just Noticeable Difference (1 JND) every 50 years. Our experience with these guidelines was the same as the Netherlands National Museum of Ethnography, who found that '[the] amount of work that such an extensive replacement program would entail…[was]…a major problem' [3]. A similar - and even more unrealistic – lighting guideline, CIE157, recommended only 1 year's display/decade for colourants in much the same lightfastness category [4]. We thought there were two fundamental problems with the otherwise reasonable approach of rationing cumulative exposure (lux-hours) over time according to the lightfastness of a colourant is and some kind of tolerance for fading. The first was obvious; a lack of reliable fading rate data, particularly in our case for a predominantly post-19th century collection. Without this there was a strong tendency for conservators to put all textiles, watercolours, writing inks, prints, colour photographs, natural history specimens and so on into the 2 year/decade category. Existing heuristic guidelines like the V&A's or CIE157 involved anxiety-provoking circular reasoning for a conservator unable to judge what the exceptions were to "most" in "most colour photographic prints with „chrome" in the name" or whether she was looking at one of the "many cheap synthetic colorants" or maybe an expensive one. The second major problem, we believed, were the clearly false underlying assumptions that all items in a collection are in equal demand for display and therefore equally likely to be exposed to light over time, and that the cultural consequences of fading were the same for a rubber duckie (unless it was Ernie's) as for a Rothko. Paradoxically, it is not unusual for treasures to be on permanent display almost irrespective of their vulnerability, because visitors keep museum doors open.

A literature review convinced us that the only workable solution to the lack of fading rate data for real objects was microfading, a rapid and nondestructive accelerated fade-test method developed in the late 1990's by Paul Whitmore [5]. We bought the components and built an instrument in 2008 which was quickly put to work screening objects destined for exhibition or loan. The V&A's emphasis on cumulative exposure (rather than lux levels alone) and their "target" of 1 JND/50 years was retained, but we allowed objects more lightfast than about BW3 to be extended beyond 2 years/decade. We also further restricted display of those less lightfast than BW2 which would have been overexposed by the same criteria.

The second problem, that of indiscriminately treating all objects as if they are equally in demand for exhibition, or all of the same importance faced with a finite budget, was contrary to the most basic collection risk management (CRM) principles, and for Australian conservators at least, their Code of Ethics [6] which states "... the AICCM member shall ensure that cultural material in her/his care receives levels of conservation appropriate to its significance and available resources. A careful re-reading of Thomson [7] also showed that he believed limiting light to 50 lux should apply to "all very valuable material[s]…that are especially sensitive to light", not everything that might fade given enough exposure. Modeling based on object lists from past NMA exhibitions showed that dividing the collection into two categories - "high" and "normal" significance - and relaxing restrictions on the latter because they are not in constant demand for display, had the potential to greatly reduce changeovers. We used a structured significance assessment scheme developed by the Collection Council of Australia to guide accessioning and deaccessioning decisions [8] of which type was also being used as the basis for various semi-quantitative CRM approaches [9] [10].

The resulting financial savings were immediate and substantial with microfading alone cutting light-driven replacement rates by about 50% because many colourants proved to be more lightfast than feared and allowing an object in a 10 year "permanent" exhibition to remain on display for 5 years instead of 2 cut the changeovers by 75%. About 10% were more tightly restricted because they were substantially less lightfast than BW2, and the rest remained in the 2 year category [11]. Both assessments - scientific and museological – unavoidably involve uncertainties, however together they act as a check on each other, ensuring that limited resources are directed to the most vulnerable objects based on both their physical and cultural properties.

Session 2 - Introduction to technique

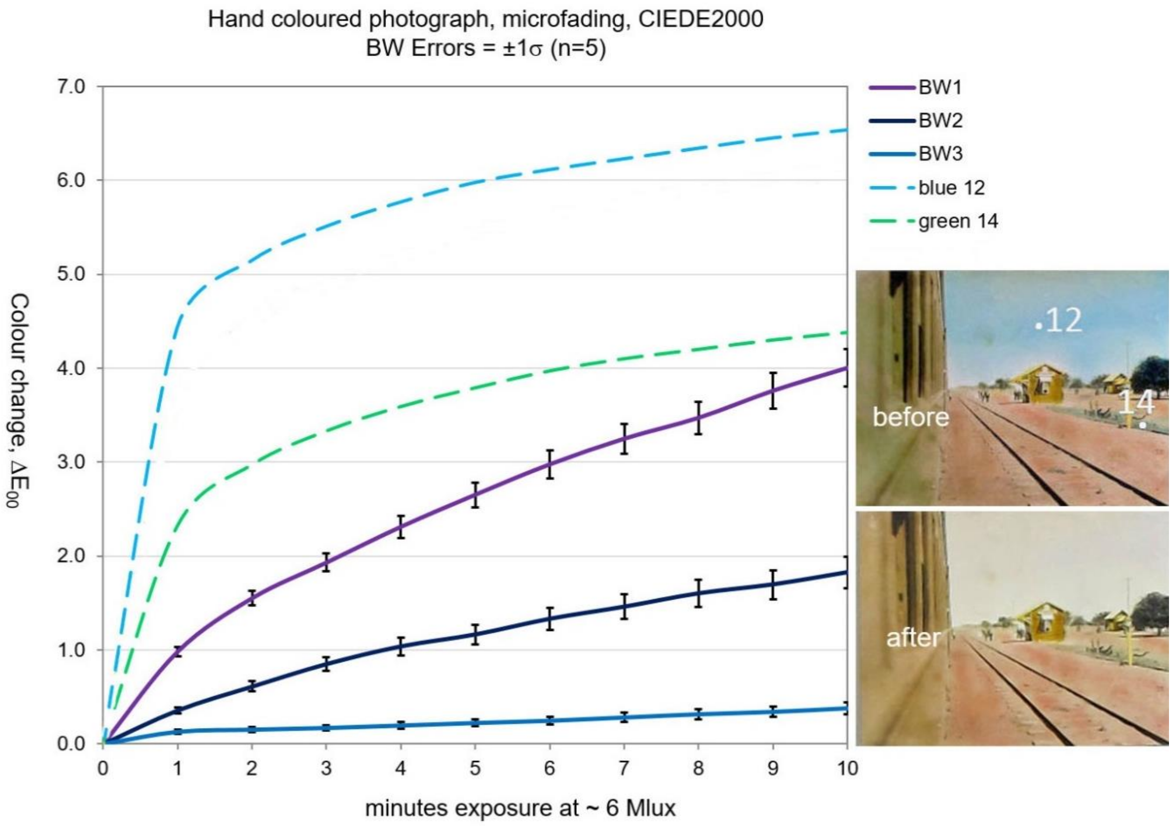

Fig. 1: A hand-coloured photograph from a photograph album that was microfade tested prior to exhibition with a recommendation for frequent page turns, but accidentally left on display for 4 years.

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An introduction to microfade testing (MFT): From a 0.3 mm high intensity light spot to specific display lighting recommendations

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Museum lighting and its possible damaging effects on sensitive cultural heritage collections continues to be a concern for many institutions around the world. The use and development of microfade testing (MFT) over the last 40 years has provided an empirical approach in which direct evaluation of an object's sensitivity to light irradiation can be determined in a relatively short amount of time. MFT offers many advantages such as non-destructive measurement on actual objects, short exposures due to the use of high intensity light sources, and evaluation of spectral changes in real time. In contrast, some potential end users have expressed concern about the safety of the technique since a large amount of energy is employed to study the response of colored areas of cultural objects at a microscopic scale. Microfading researchers around the world have described the size, energy, and shape of the illuminated spot used for these tests. The reports are in agreement and indicate that a round spot with diameter in the 0.3-0.7 mm range is safe and can provide valuable information about the light-sensitivity of collections. These data are later analyzed in the context of preventive conservation and museum lighting recommendations by considering an individual object, a collection, and the museum environment. A series of MFT

Session 2 - Introduction to technique

case studies will be presented to describe how this methodology is used as part of preventive conservation initiatives in cultural institutions around the world. The methodology consists of testing colored areas of an object with the aim of detecting the presence or absence of highly sensitive colorant systems. If such systems are identified within an object, specific lighting recommendations are individually planned and implemented for that particular object. On the other hand, MFT results also serve to provide more access to collections that were initially assumed to contain highly sensitive materials, but instead showed high resistance to light after microfade testing. It has been demonstrated that a small high intensity light spot used to evaluate the response of colored areas of cultural objects can have an enormous impact on the formulation and implementation of museum lighting guidelines.

Session 3 - Interpretation and implementation

Influence of lighting environment on MFT interpretation: adjusting the interpretation of MFT results when considering exhibition conditions such as spectral shape and overall luminosity

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This talk will cover corrections that one can choose to apply to the interpretation of MFT data, in situations where the lighting experienced by an object is not easily alterable and/or is significantly different than that assumed during standard data interpretation. The relative roles of spectral distribution, molecular action spectra, and overall lighting intensity will be discussed. In this manner, the impact of pre-existing knowledge of lighting conditions and photo-chemical behavior on MFT interpretation can be assessed. Applications to tested art objects as well as to comparisons between MFT and conventional light aging tests will be discussed.

Session 3 - Interpretation and implementation

Setting a preservation target and using the microfading test results in order to implementing lighting policy for vulnerable artworks

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Light exposure constitutes an important risk for cultural heritage collection items that should be carefully controlled and properly managed.
First step to implement proper lighting policy for vulnerable collection requires setting a Preservation Target (PT) that defines the light exposure conditions under which, for a given timeframe, access to values of the given item is maximized, while loss of its value(s) induced by its exposure to light is minimized. It will be emphasized that setting a PT should result from collaboration between curator and conservator and that it provides with the indispensable frame in order to implement lighting policy adequate for vulnerable collection items.
Identifying vulnerable colors on cultural property is a second aspect of considerable importance for informing collection lighting decisions. In preventive conservation color change is often used as an indicator for light induced degradation: light sensitivity of a material is then assessed by plotting the color change (in ΔE) induced on the material by increasing total exposure (in lux.hour). Microfading permits assessing directly light sensitivity of a collection item as it allows in situ accelerated light ageing on a sub millimeter spot of the item surface. The presentation will describe how using the quantitative data obtained with microfadetesting in the completed framework for lighting policy decision provided after setting a PT. It will be presented how such approach allows conservator to select lighting scenario for which value(s) of artwork on display are best presented and that also minimizes risks of value loss by aligning with the light-dose set by the PT.

Session 3 - Interpretation and implementation

Light damage – perception, risk, and mitigation

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This presentation deals with the question of how to display light sensitive museum collections whilst minimizing undesirable light damage. The main focus of the lecture is human vision, colour measurement and what that means, and measures to reduce light damage without compromising the quality or the feeling of the exhibition. How do you see colours, how can we measure colour change and light sensitivity, and what consequences can be drawn from such measurements? These questions are discussed in the lecture and examples of successful (and not so successful) light schemes and damage mitigation strategies are presented.

Session 4 - Practical presentation

With or without UV – examples of microfading with near UV

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The microfading tester (MFT) at the HfBK Dresden is in use since 2014. In the last two years many historic and modern objects have been tested on their light fastness. Besides the standard illumination setting of MFT (uv-filtered light of a Xenon-lamp), the possibility of including near UV to the spectrum of illumination was tested. This option allows broader application of the MFT. After a brief introduction to the technical requirements for a MFT measurement with UV, some case studies will be presented. One example is an almost completely bleached sculpture of Zephania Tshuma, the other example is about the selection of modern materials for a digital reconstruction as part of a restoration. In these cases MFT measurements delivered valuable information for conservational decisions and helped to explain damage phenomena on coloured works of art.

Current case studies from the collections of the National Museums in Berlin

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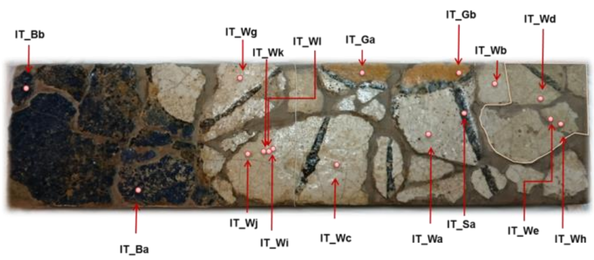
Polychrome artworks are prone to change their colour due to illumination. For preventive conservation issues, photo-sensitivity of the objects has to be considered in order to optimize their exposure to light.
This talk gives an overview of the studied objects and research questions to be investigated by means of microfading testing (MFT) from the collections of the *Staatliche Museen zu Berlin-Preußischer Kulturbesitz* (National museums in Berlin-Prussian cultural heritage foundation).
Microfading testing is now an internationally recognised method to evaluate the light fastness of museum items. The *Rathgen-Forschungslabor* was the first laboratory to run a MFT in Germany. Several MFT projects have been carried out over the last years, in cooperation with the collections of the National museums in Berlin, on different artworks.
Among others, the following case studied are highlighted: the study of the Picasso‘s Dove of Peace on cloth *(Kunstbibliothek)*, the Fineliner and rollerball pen drawings and the Leoni drawings on blue paper *(Kupferstichkabinett),* sketches from the Ken Adam Archive *(Deutsche Kinemathek),* Maya blue on ceramics *(Ethnologisches Museum),* the Mesoamerican cotton cloth Lienzo Seler II *(Ethnologisches Museum)* and last but not least even glaced bricks of the Ishtar gate *(Vorderasiatisches Museum)* that are in principle supposed to be light fast.



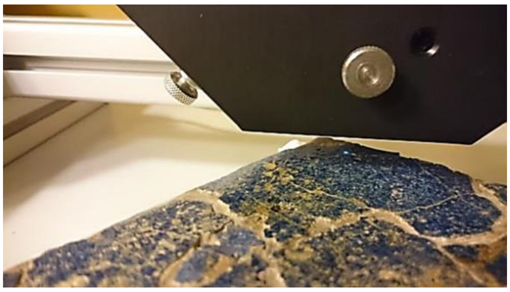


Fig. 1: Microfading testing of a reconstructed Babylonian glaced brick (VA Bab 01478-114) of the throne room facade of Nebuchadnezzar II of the Vorderasiatisches Museum

User Meeting

Challenging cases of micro fading applications

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The Rathgen-Forschungslabor as the scientific laboratory for the Staatliche Museen zu Berlin has to deal with a great diversity of assignments from seventeen museums. Three particularly challenging cases from the broad variety of objects that were analyzed by microfading testing (MFT) in our laboratory or *in situ* are presented here (Figure 1).

1) Because of its size of about $4m \times 4m$, the Lienzo Seler II, a Mexican cotton cloth map from the early colonial time (~1520 A.D.), had to be tested *in situ*. For the first time, our MFT device was taken out of the laboratory and was adapted to perform vertical measurements. The lienzo shows already a very high degree of fading; some of the writings even almost vanished. Nevertheless, it is essential to determine its actual light sensitivity in order to find a suitable policy with the purpose of preserving it for many years with a minimum of light damage.
2) A previous MFT investigation on glazed bricks from the Ishtar gate has shown an exceptionally high light sensitivity. An extensive second investigation was carried out in our laboratory in order to corroborate that results and possibly find out the origin of the high sensitivity in a material that commonly is not light sensitive.
3) The light sensitivity of modern ink pens and contemporary drawings was also investigated. Aside from the fact that several pens used by contemporary artists and graphic designers were not intended to be permanent, the light sensitivity of drawings depend on additional factors like the density of the colorant due to the pressure and speed of the pen while drawing. The MFT analysis of contemporary drawings by Jorinde Voigt and Sol LeWitt and a series of laboratory tests on commercially available ink pens (fine liners or roller ball pens) are extensively discussed here.

Fig. 1: Left: Lienzo Seler II, Ethnologisches Museum. Middle: Ishtar Gate, Vorderasiatisches Museum. Right: Contemporary pen drawings, Kupferstichkabinett

Limitations and concerns associated with microfade testing (MFT)

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MFT is a very robust technique that provides information about the photostability of colorant systems found in cultural heritage objects. Although the technique has been extensively used by museums and other cultural institutions, there are still some limitations and concerns associated with its use on actual artworks. In general, there is a lack of consensus regarding the problems that need to be addressed.

Moreover, researchers and end-users usually have diverse backgrounds resulting in difficulties at the time of developing a comprehensive experimental program. For example, MFT allows analyzing the spectral change in real time induced by irradiation of a small area, typically in the 0.3-0.5 mm range. This feature has been identified as an advantage due to the size of the illuminated spot, which allows to conduct tests on actual objects. However, this characteristic of the technique has also been associated with under-representation as measurements are conducted at the micro scale requiring a large amount of points in order to produce representative and statistically significant data. Reproducibility of data has also been identified as an issue. For this reason, an interlaboratory trial testing campaign was designed and coordinated by Bruce Ford at the National Museum in Australia in 2010. This study revealed that colorant systems containing materials with high sensitivity to light tend to show higher inconsistencies in MFT analysis. The evaluation of change through the use of various color spaces has resulted in disagreement among researchers at the time of selecting the most adequate system for evaluating cultural heritage objects.

Furthermore, one of the most important issues associated with MFT is reciprocity. Since the technique is frequently used for museum lighting and exhibition management, the possible deviations from natural aging processes due to the high intensity of the light source used continues to constitute a major issue at the time of interpreting the data and evaluating the results in the context of museum gallery exposure. Deviations from natural aging processes have been reported for extremely and highly sensitive systems resulting in a proposal for reducing the output of the MFT for materials considered to be especially sensitive. The safety of the technique has also been questioned by many users, but numerous researchers have investigated this problem and have demonstrated that the technique can be safely applied on actual objects and operating procedures that take this aspect into consideration have been developed.

Although MFT, as any other analytical technique, has some disadvantages, it has been demonstrated that its advantages are numerous and outnumber these limitations. Overall, the light sensitivity of objects was typically based on general and traditional knowledge about their materials. However, it is important to emphasize that MFT has provided a unique way of evaluating light stability and classifying objects based on a spectral response that can be determined empirically.

Fading behavior of blue wool #1 over four decades of lighting intensity

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We have studied changes in the reflectance properties of Blue Wool #1 from 6 to 15000 Klx, and performed LC/MS measurements of dye extractions for degradation in regions of transition-like behavior. The results, combined with previous literature, suggest that three different regimes of reciprocity failure exist. Their varying impact on the use of Blue Wool #1 as a reference standard for accelerated light aging measurements, depending on the regimes being compared, will be discussed. An interpretation of the photochemical nature of the behavior will also be presented.

Determination of light fastness of bookbinding fabrics using microfadometer system in The National library of Czech Republic

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Light is the one of the most serious damaging factors of the materials of books such as paper, textile, paints, etc. The talk will present use Microfadometer system to exact determine the degree of bookbinding fabrics sensitivity to light. The results are used for the creation of conservation strategies, to protect the book collections from light in the study rooms and for the selection of stable materials for conservation, for rebinding books and for

predicting the color changes during long-term exposure to light in the exhibition. Knowledge of light fastness of library collections materials is necessary for the creation of an operation procedure to protect collections of books in library containing materials which could be damaged by light.

Colour monitoring and microfading in Old Masters Picture Gallery, Dresden

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Since January 2015 a cooperation project between the Dresden Old Masters Picture Gallery and Lab of nature sciences in conservation at the Academy of Fine Arts Dresden has lunched. Background of the project is on the one hand the redevelopment of the Old Masters Picture gallery. And on the other hand the need of controlled illumination levels for the paintings and the known poor light fastness of Prussian blue. One highlight of the gallery is the work of Bernardo Bellotto called Canaletto with his famous views of Dresden in the 18th Century. In his paintings Prussian blue was detected.

Microfading tests on the more than 200 year old paintings have confirmed, that the parts containing Prussian blue are still losing colour.

The ongoing project combines two methods. First, Microfading tests and prediction of colour change on self-made samples of Prussian blue and other colours. These tests are made to predict the colour change of the samples, which are exposed to different illumination levels in the gallery. And second, colour monitoring with conventional colour measurement of the samples and the paintings of Bellotto.

The aim is, to get deeper knowledge about relation between predicted and real colour change and to prevent further colour change in Bellottos paintings.

User Meeting

A comparison of the results from microfading and conventional light ageing tests

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A custom-built microfade tester has recently been set-up by the British Museum and is currently used to assess the light fastness of materials for which there is very little data available on their light fastness (see Figure). Microfading may be regarded as an extremely accelerated light ageing technique and currently uses ISO blue wool standards as benchmarks. Experiments were conducted to compare microfading results with light ageing techniques carried out in a lightbox and an environmental chamber. Tests were conducted on a range of samples: sets of blue wool standards from different manufacturers and of different age, Lightcheck® Sensitive (a museum light dosimeter made of a light sensitive coating on a glass substrate), six un-dyed cellulose-based materials (cotton, raphia, linen, jute, newspaper and Whatman® filter paper) and seven dyed threads made of different materials (wool, cotton and alpaca). It was found that the blue wool standards sets did not always fade to a similar extent depending on their age and manufacturer, and also that the results obtained by the different accelerated ageing methods did not always agree. The Lightcheck® Sensitive faded greatly in the lightbox (ΔE=16.4), but faded to a much lesser extent in the microfading test (ΔE=3.4). For the cellulose-based materials, colour change data under natural ageing gallery conditions were available and compared to the results of the accelerated ageing tests: the colour change was considerably greater under gallery conditions. This is not surprising as colour changes in undyed cellulose-based materials are not governed solely by photo-chemical processes, but this observation serves as a reminder of the limitations of microfading. In this study, microfading was successful at identifying the least lightfast dyed threads, which suggests that it is a useful risk management tool. In the long term, it is recommended to investigate alternatives to blue wool standards as microfading benchmarks.

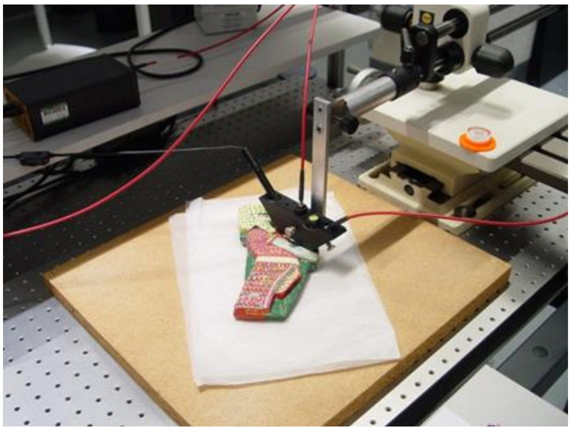

Fig. 1: Investigating the lightfastness of an object made of recycled food wrappers

Alternative perspectives on blue-wool-standards in microfading

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Blue Wool Standards are widely used in light fastness tests as reference. In microfading their use is common as well, although their surface and structure is not ideal for testing with a sub-millimeter spot of illumination. The talk will give an overview about precondition of microfading measurements on BW-Standards.

Furthermore some preliminary studies on the alternative use of BW standards and the evaluation of the results will be presented and discussed:

- Manufacturing of BW-pellets and comparison of fading with conventional BW
- Single yarn fading
- Evaluation of fading-rate instead of absolute colour change

Color change, causes, perception and interpretation. How to interpret the color change (ΔE) induced by MFT?

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Light exposure can induce photo-chemical processes that result in irreversible color change of the illuminated material. This change can be so extreme that it may compromise the value presentation of the cultural item on display. In order to implement proper lighting policy, it is important to know the light sensitivity of item on display that is often expressed as the relationship between light dose and color change. Light sensitivity of a collection item can be assessed by microfading, an accelerated light aging method that directly tests the item by exposing a submillimeter spot on its surface to a very intense visible light and measuring in real time the color change (ΔE) induced by the test.

It will be shown that while Color Change is a relevant and easily measurable parameter to use in order to express the Preservation Target related to light exposure, its subsequent interpretation is however not always straight-forward due to the symptomatic nature of such change. Presentation will explore and discuss how the inherent ambiguity related to the induced color change can potentially lead to improper interpretation of MFT results.

User Meeting

Various mechanisms leading to similar measurable color changes will be exemplified, their perception discussed along with their respective impacts on the value presentation of the cultural item on display. Relevant criteria on which a surface spot should be selected and its behavior considered “representative” of a larger area will also be briefly discussed in relation to proper interpretation of the MFT results and their subsequent use for lighting policy implementation.

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