Interactions between Museum Lighting and Optically Coated Glazing

Introduction

Glazing is increasingly being used within museums and galleries to protect works of art and cultural heritage. This can take the form of a sheet of glass or acrylic within the frame for 2D material, or as cases and vitrines for 3D items. The benefits of such protection are manifold, from the obvious physical barrier to prevent theft and vandalism, to acting as a buffer against fluctuating environmental conditions. However, there are often many curatorial concerns with using glazing. Depending on the type of material used and the lighting conditions, glazing can impact upon the aesthetics of an artwork or artefact, potentially altering viewer engagement and understanding of a piece.

Fig. 1 Reflections on glazed art work can be highly distracting – hindering true appreciation and understanding of the piece

Thin-film Coatings on Glazing for Art and Heritage

Thin-film coatings can be applied to glazing materials to provide a range of characteristics. The most immediately obvious of which is to reduce reflections. Tru Vue uses sputter coating to physically and chemically bond layers of metal oxides to glazing materials, which reduce reflections by creating optical interference. With these coatings reflection can be reduced to 1% or less. In turn, visible light transmission through the glazing will be increased to 98% or more. Aesthetic appreciation of an artwork will be improved by both the removal of distracting reflections and by allowing more visible light to fall on the work, potentially allowing for greater clarity of fine detail and a more realistic interpretation of the colours.

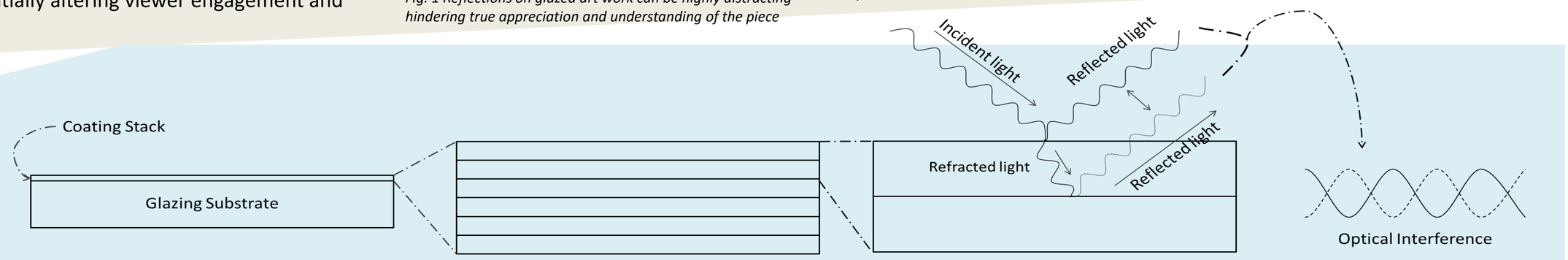

Fig. 2 Creating Optical Interference

Reducing Reflections via Optical Interference

When light, travelling as a wave, falls on a piece of glazing, three things will happen. Some will be reflected, some will be absorbed by the glazing material, and some will travel through. Reflections can be reduced by using several layers of thin-film coatings to create optical interference. By managing the reflections off each layer of material, the reflected light waves can cancel each other out. Since visible light will be travelling in a variety of wavelengths, reducing the overall reflection is a delicate balance based upon the refractive index of the material used for each coating layer, its thickness, and its position within the coating stack. Any residual reflections seen in optically coated glazing will have a colour to them. This colour will depend upon the type of light source, its colour temperature, and the type or brand of glazing material used.

Reflection Intensity

Regular glazing reflects approximately 8% of light falling upon it. With low reflective coatings, reflection can be reduced to less than 1%. However, the amount of reflections seen will depend upon the illuminance of the work – 1% of daylight falling on a glazed painting could give reflections that are far more obvious than an LED light, in a closed gallery space, where the light levels are set to 50lux.

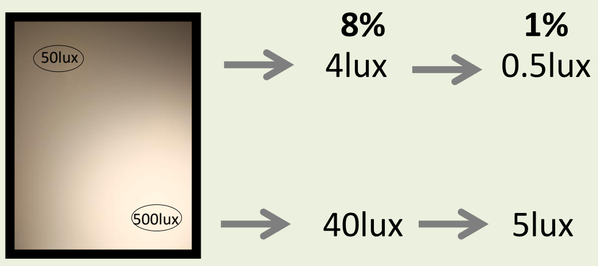

Fig. 3 Difference in reflection intensity

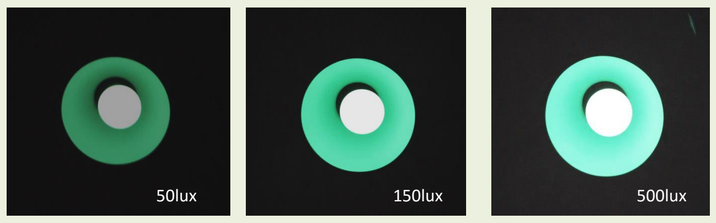

Fig. 4 Reflection of 4000K LED seen in Optium Museum Acrylic with black background at varying illuminance measured with Sunche Professional Illuminance Meter

Light Source

Lighting technology is developing rapidly with an increasing use of LED's. Since different light sources have different spectral distributions, if a glazing material manages reflections by creating optical interference between wavelengths, then the type of light source will impact both the amount and appearance of any reflections seen. Many museums and galleries have multiple light sources in an exhibition space. Further there can be reflected light off walls or other exhibits. This can lead to reflections of multiple colours on any glazed works. Ideally, when choosing glazing material, samples should be viewed under exhibition lighting to see if the reflections are distracting. Since daylight is a complete spectrum light source, and tends to be higher in intensity than others used within an exhibition space, reflections from daylight sources will appear the most intense. In situations where daylight may fall on a work, it could be preferable to have regular UV protective glazing since although reflections may be brighter, the neutral tone may be less objectionable than the colour seen with optically coated glazing.

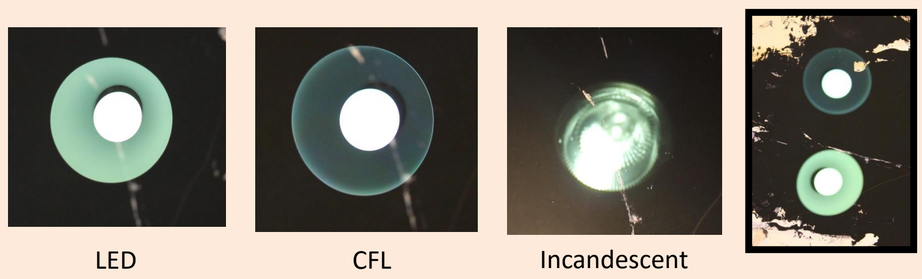

Fig. 5 Comparison of reflections of light sources in Optium Museum Acrylic at 150 lux – all sold as 2700K

Effect of Colour Temperature

The 'correct' colour temperature for the display of an artwork is one of the hot topics of debate when it comes to museum lighting. The decision of which colour temperature to use can depend upon a variety of factors ,from damage potential to the subject of the artwork. It is important to realise when lighting an area with glazed artworks, that if the glazing has optical coatings to reduce reflection, any residual reflections will have a colour to them. The colour of any reflections seen can vary depending upon the colour temperature of the light source as shown below.

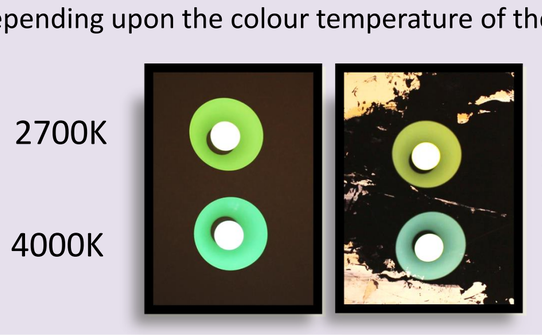

Fig. 6 Comparison of reflections seen in Optium Museum Acrylic at differing colour temperatures. Both sources Hyperikon LED "CRI90+" . Light levels set to 150 lux measured with Sunche Professional Illuminance Meter

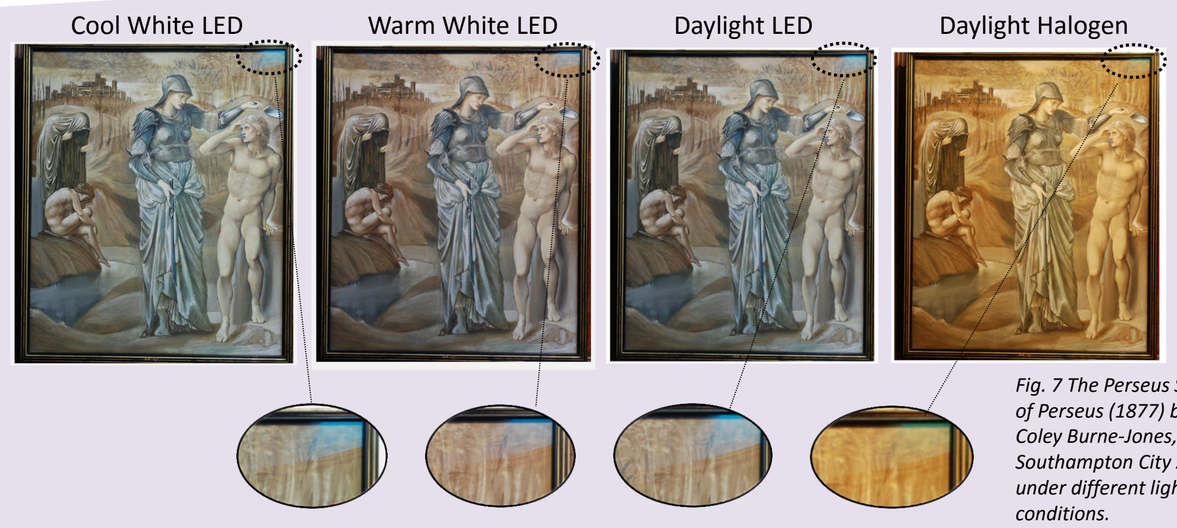

Fig. 7 The Perseus Series: The Call of Perseus (1877) by Sir Edward Coley Burne-Jones, Southampton City Art Gallery, under different lighting conditions.

Figure 7, above, demonstrates not only how colour temperature and light source can affect the appearance of an artwork, but also the amount, colour and intensity of any reflections seen on the artwork's protective glazing.

Fig. 8 In an ideal world, light sources would be placed at a high, sharp angle to a work, causing any residual reflections to de directed towards the ground. In reality, many exhibition spaces have light from multiple directions including across the room. These can cause reflections at eye level.

Conclusions

Decisions on lighting for an artwork or exhibition space should not be taken in isolation from any glazing material placed in front of the work. In terms of light, glazing is often seen solely as a potential barrier to UV. Optical coatings on glazing material can reduce reflections to 1% or lower. In these situations light transmission can increase to 98% or higher. Whilst this can aid with the aesthetic appreciation of the artwork, any tests of colour fastness under visible light should take this into account. In a perfect lighting scenario, light would be falling from a high sharp angle and thus any reflections would only be seen at a low angle towards the ground. However, in most exhibition spaces there will be multiple light sources, potentially including reflected light from other surfaces, and so some reflections may be seen. Reflections on optically coated glazing will have a colour and the colour and intensity of reflections will depend upon the source of light.

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