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A Review of Optically Active Coatings PACE2009

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Inorganic vs Organic OAA's

There a two common types of Optically Active Additives or Optically Active Pigments available commercially, inorganic and organic.

Inorganic OAA's exhibit relatively large particle size: 5 - 10um (no mobility), are light stable, can have a choice of colours, are useful in a wide range of coating systems, and are more expensive. Operates at 365nm.

Organic OAA's exhibit low addition level, are soluble in solvents and organic liquids (mobile), are blue under UV (same colour as lint, oil, grease etc), can fade quickly, have limited use in a range of coating systems and are less expensive. They are also indistinguishable from old coat-tar epoxy type coatings still seen on some structures and vessels. Operates at 365nm and 405nm

Useage

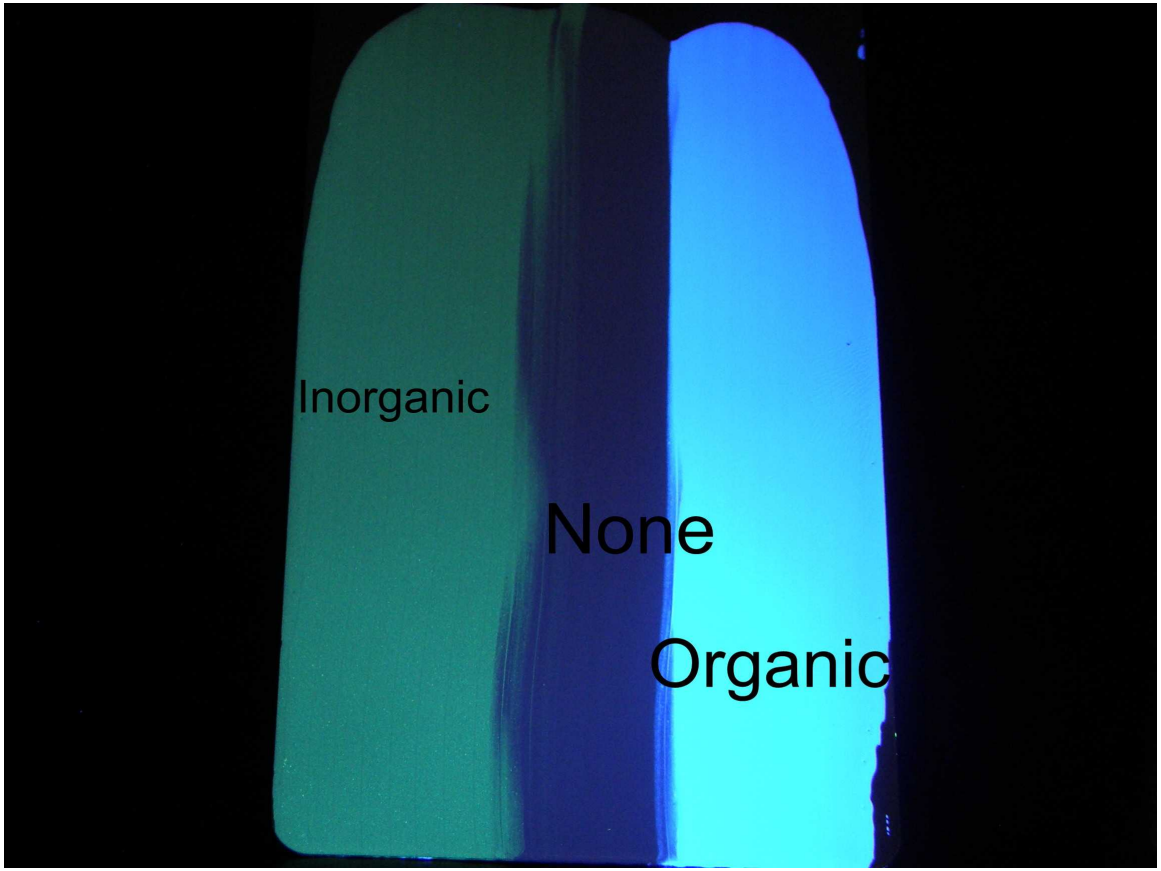
365nm is used or has been used in:

UK, China, Korea, Vietnam, Singapore, Malaysia, Dubai, Bahrain, Poland, Denmark, Germany, Norway, Finland, Netherlands, Portugal, Libya, Morocco, Canada and USA.

405nm is used in:

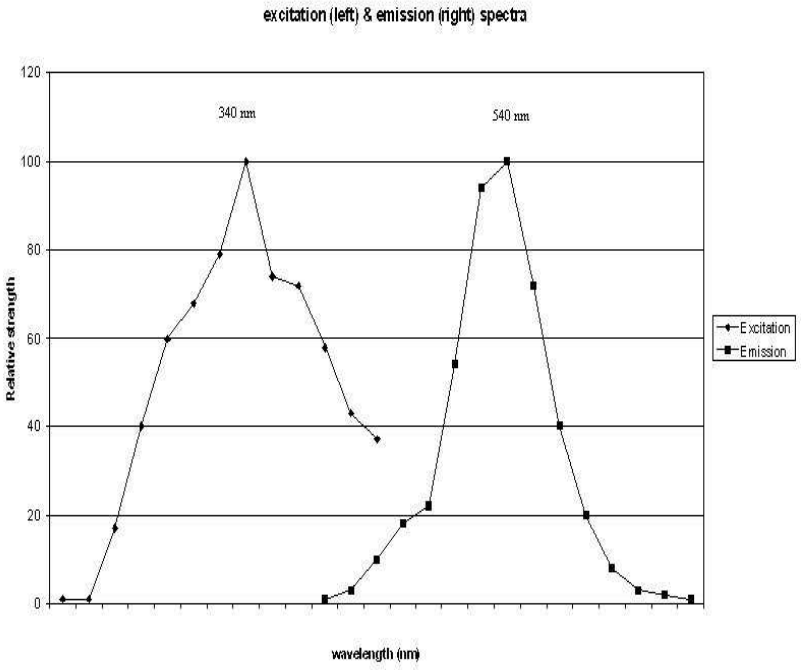
USA and possibly Canada.

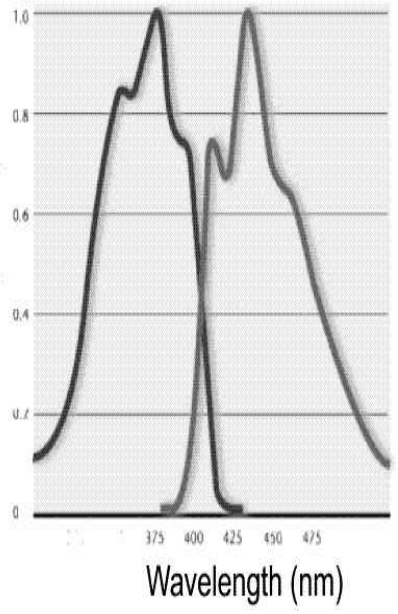
Reaction to 365nm and 405nm



Organic OAA's have a more pronounced reaction to 365nm and 405nm than Inorganic OAA's making them more suitable for use in single coat applications. However care should be taken if any over-coating or repair is liable to take place.

Typical Excitation & Emission Spectra of OAA





Inorganic OAA

Organic OAA

Visual Contrast

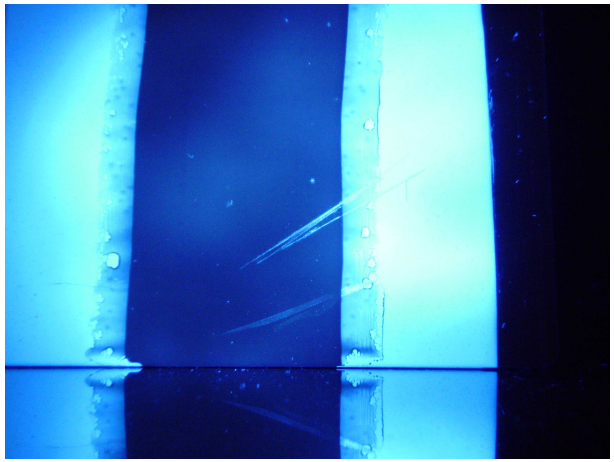
One of the problems that arise when viewing under 405nm is the lack of contrast between the activation source and the emitted energy. At 405nm the organic additive is only functioning at 40% efficiency and the difference in wavelength between the activation source and the emitted energy is only 45nm at best. Using inorganic additives the efficiency is almost 100% and the difference in wavelength is almost 180nm…… put simply the 405nm lamp puts out too much visible light to allow for all the defects to be seen.

Ambient Light vs 405nm vs 365nm

Ambient

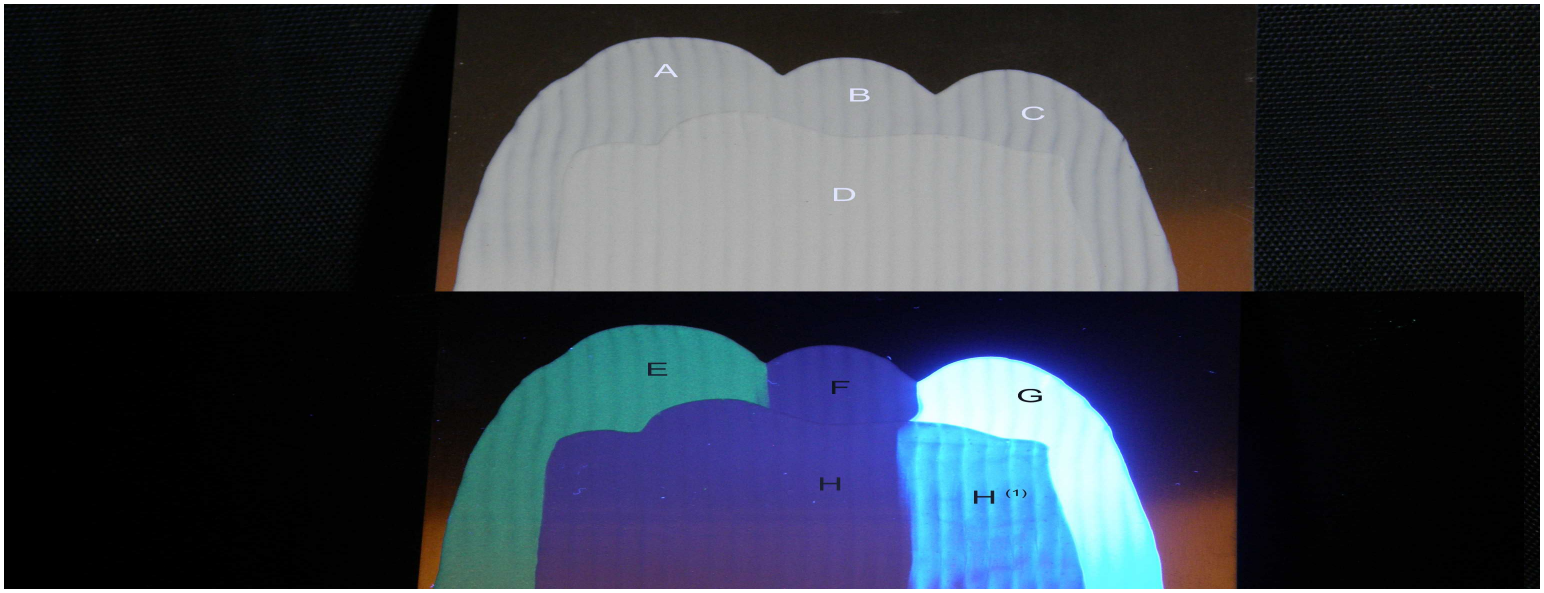
405nm

Organic only as inorganic has little reaction at 405nm



365nm

Mobility of Organic and Inorganic OAA's



A: Epoxy with Inorganic OAA under ambient light B: Epoxy under ambient light

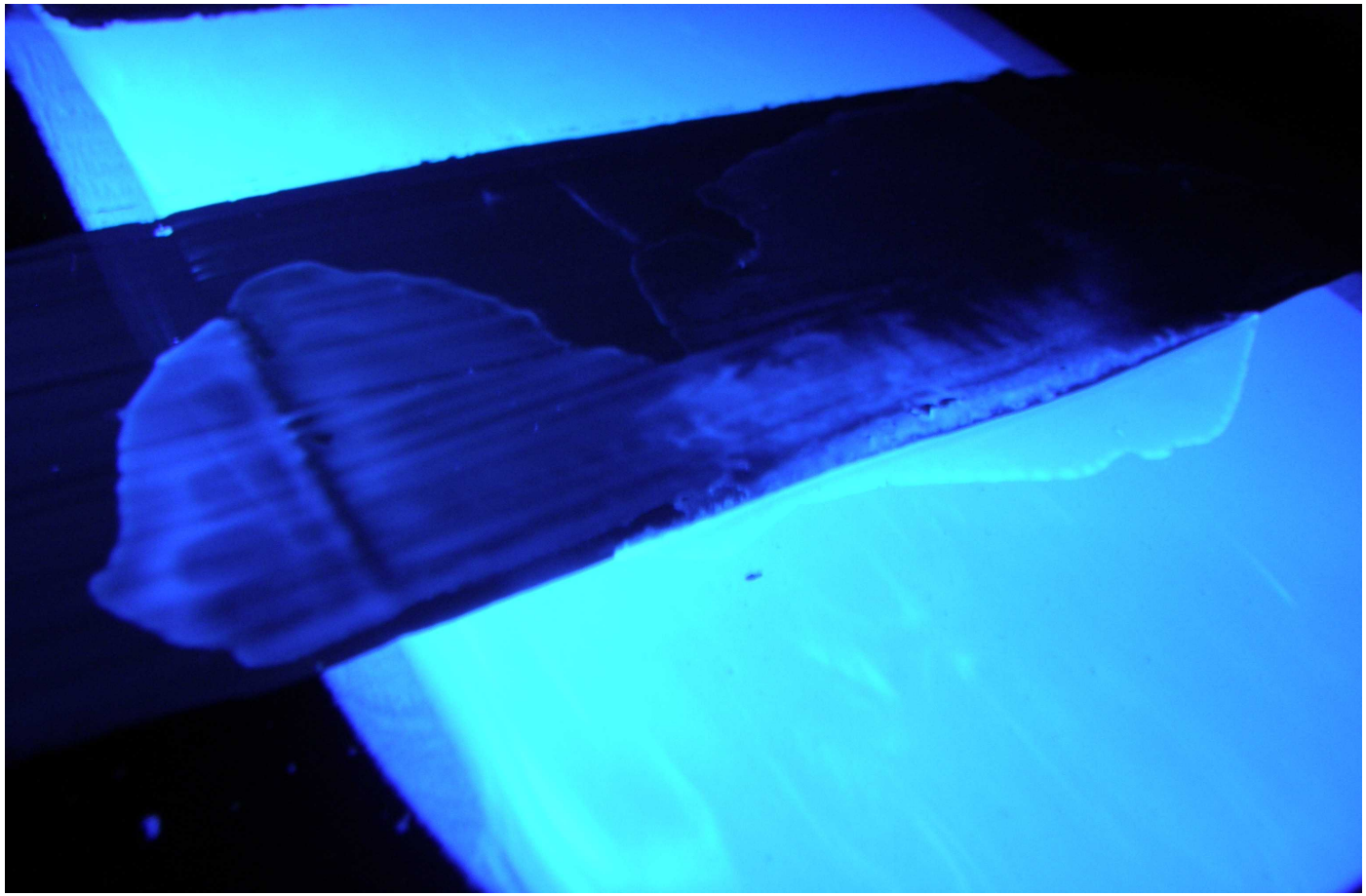
C: Epoxy with Organic OAA under ambient light D: Epoxy second coat under UV light

E: Epoxy with Inorganic OAA under UV light F: Epoxy under UV light

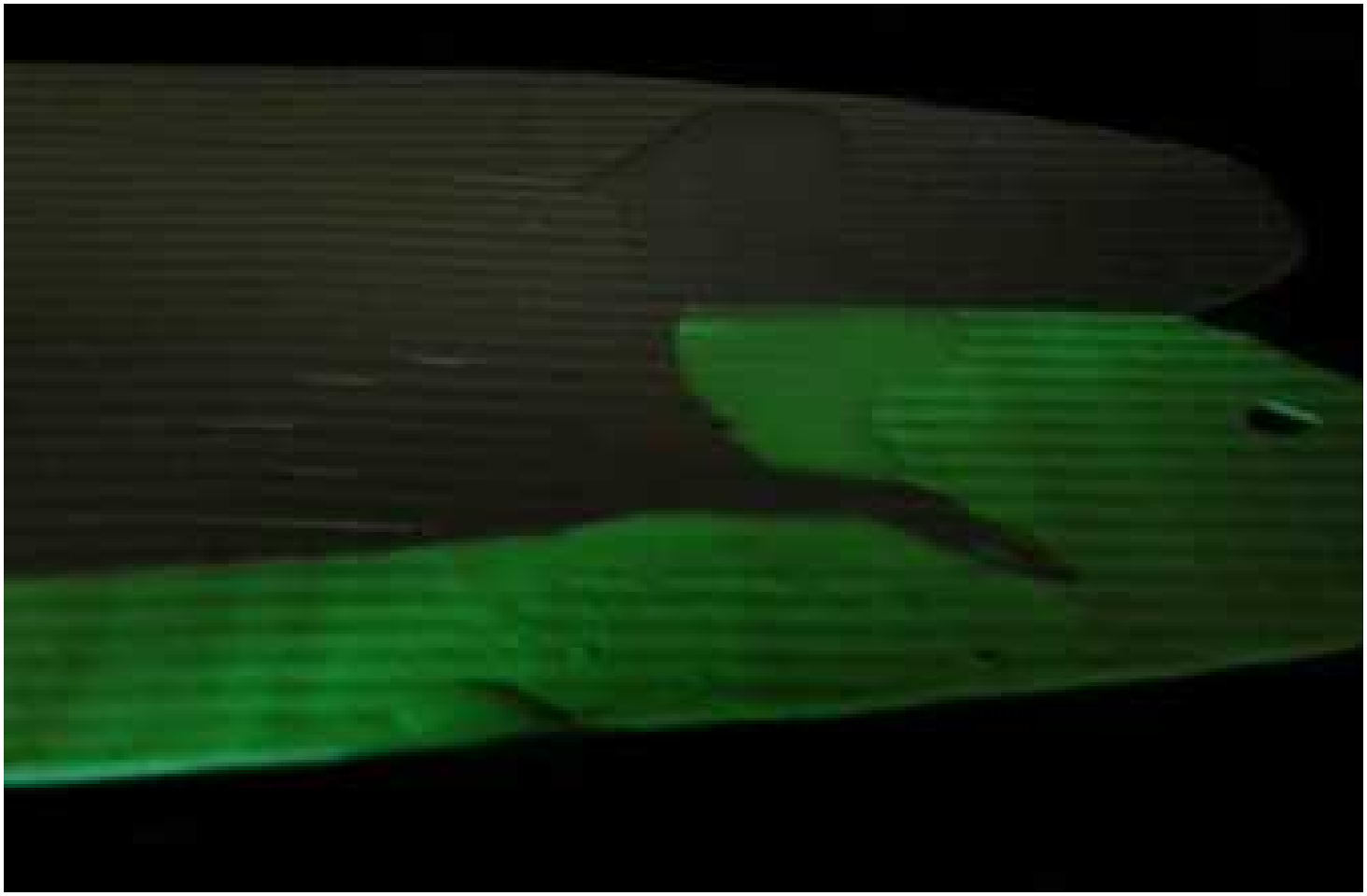
G: Epoxy with Organic OAA under UV light H :Epoxy second coat under UV light

H(1):Epoxy second coat under UV light (note migration of Organic OAA through second coat)

Organic OAA with Solvent

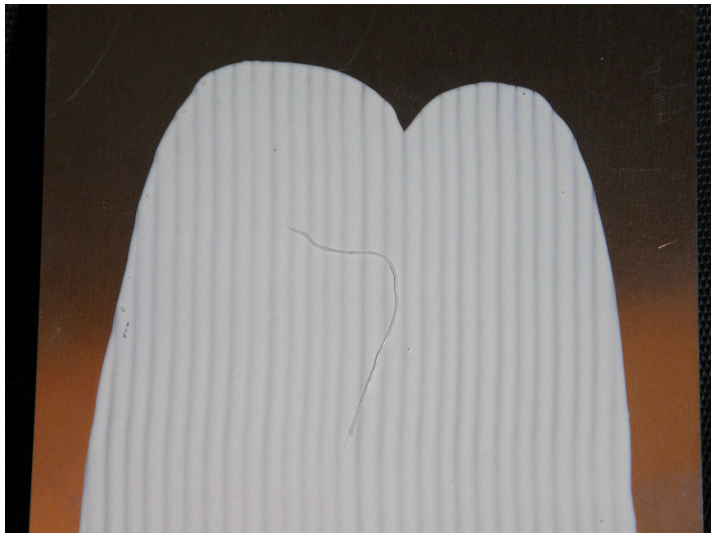


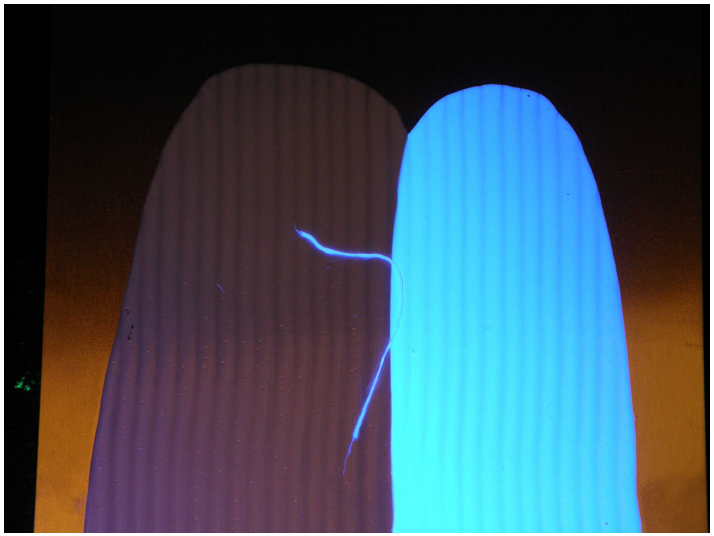
Inorganic OAA with Solvent



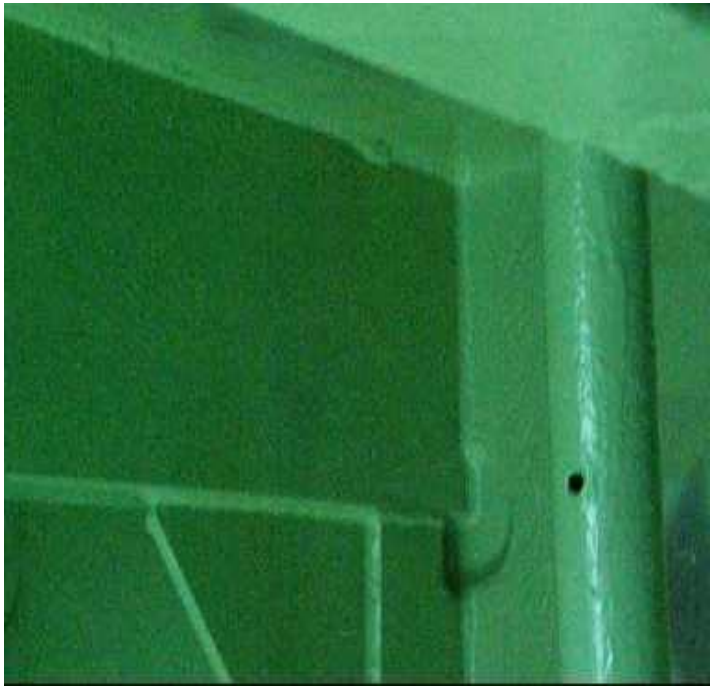
Thread, Lint etc under UV

Oil, grease, lint and fibres can give false indicators when viewed under UV.

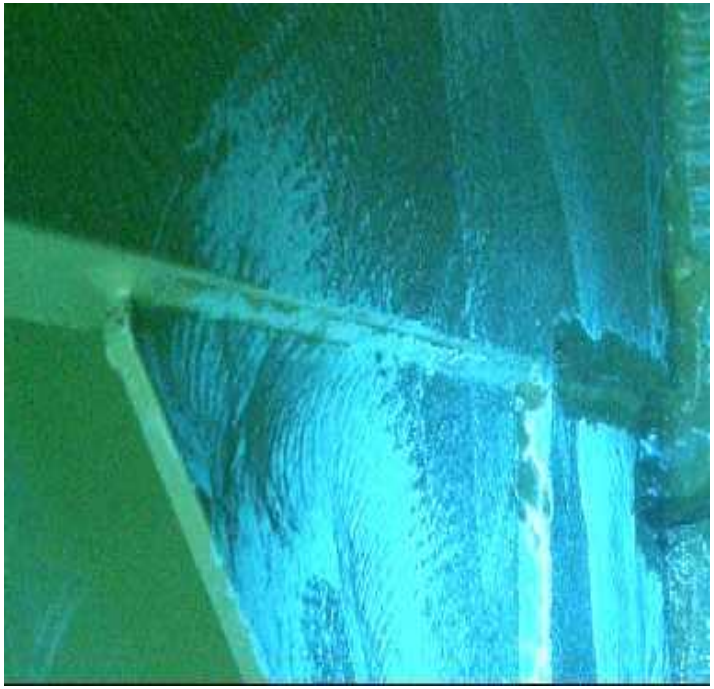




Coal Tar Epoxy Over-coated (No OAA)

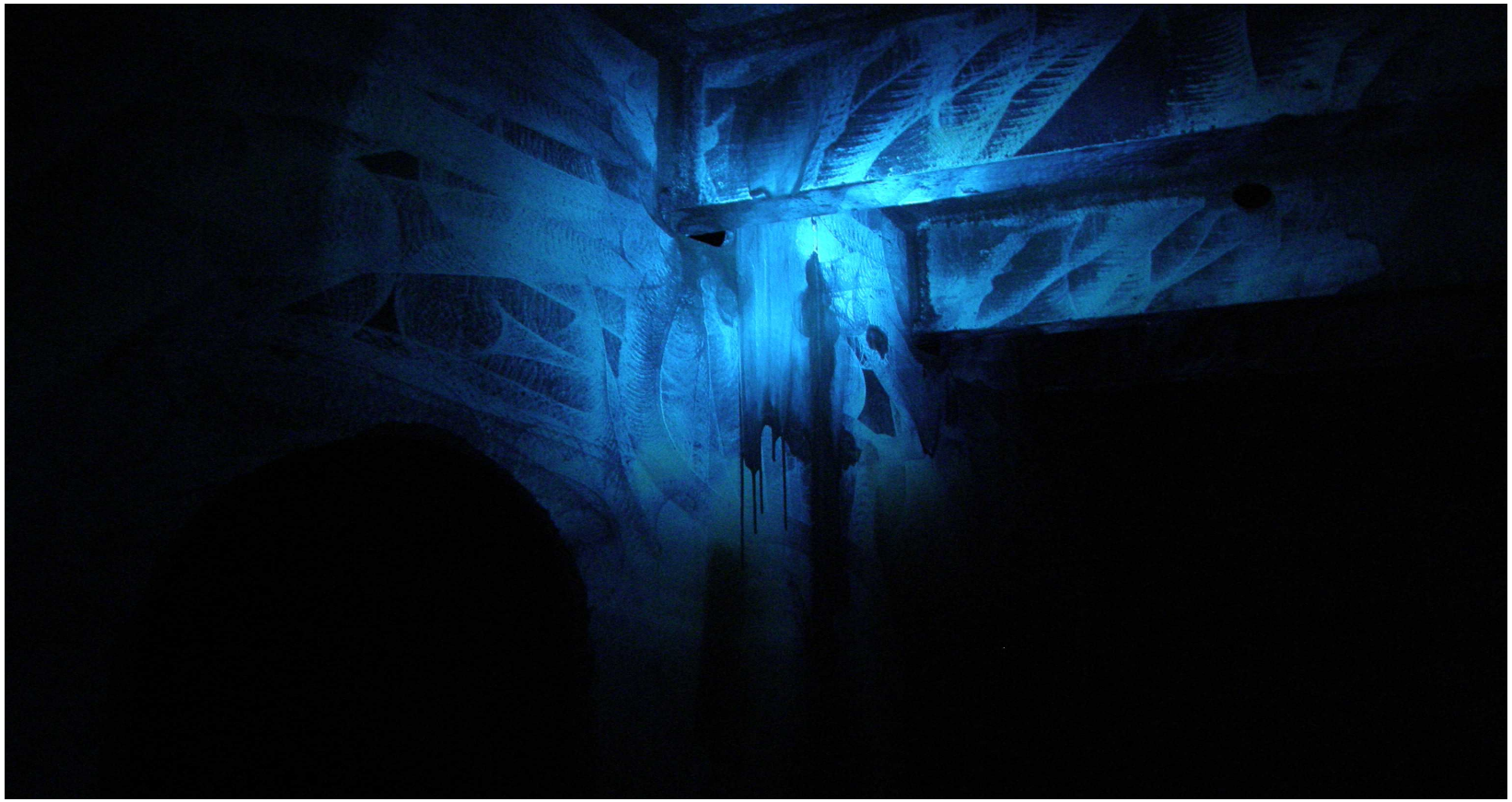


ambient light



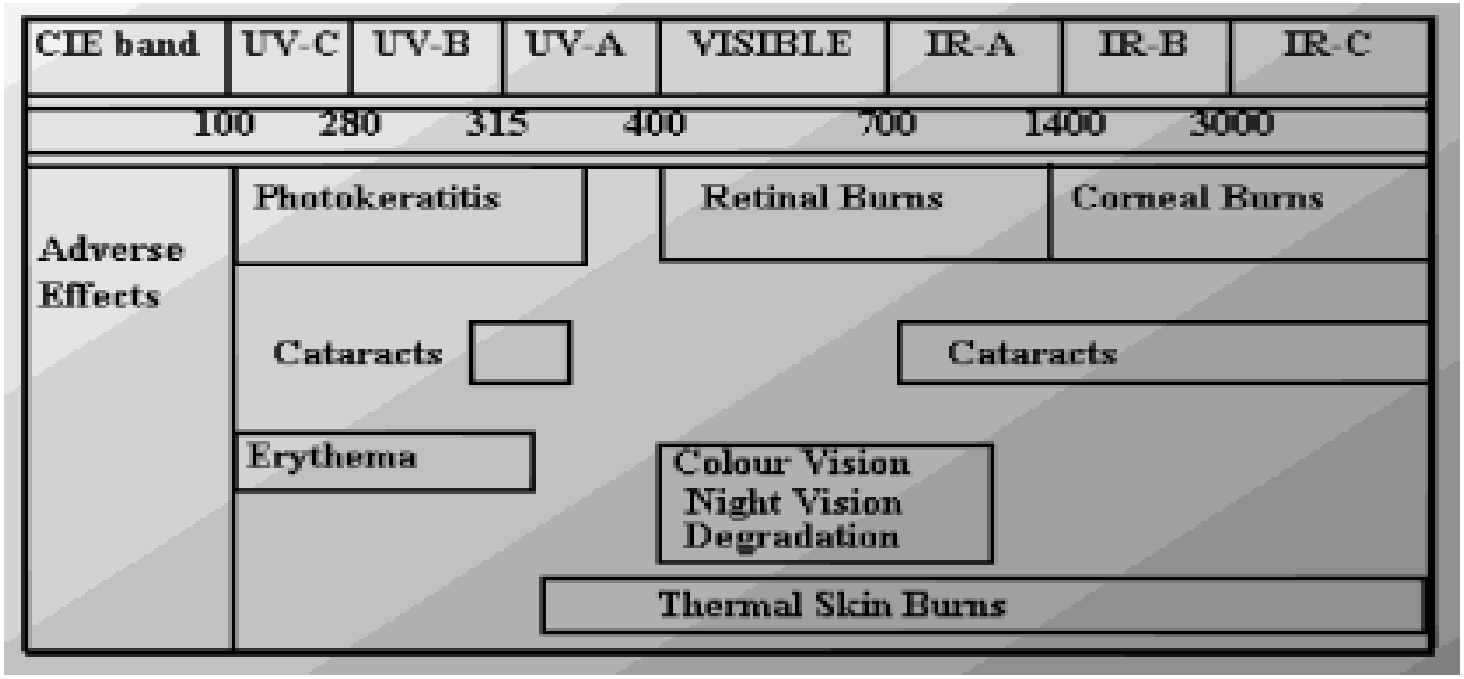
UV

No OAA under UV



Safety

UV vs Blue Light (365nm vs 405nm)

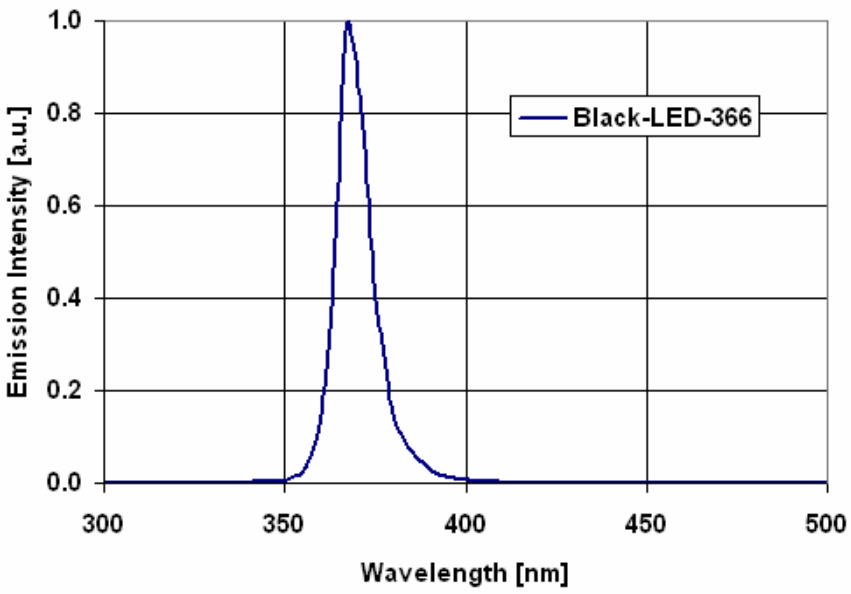


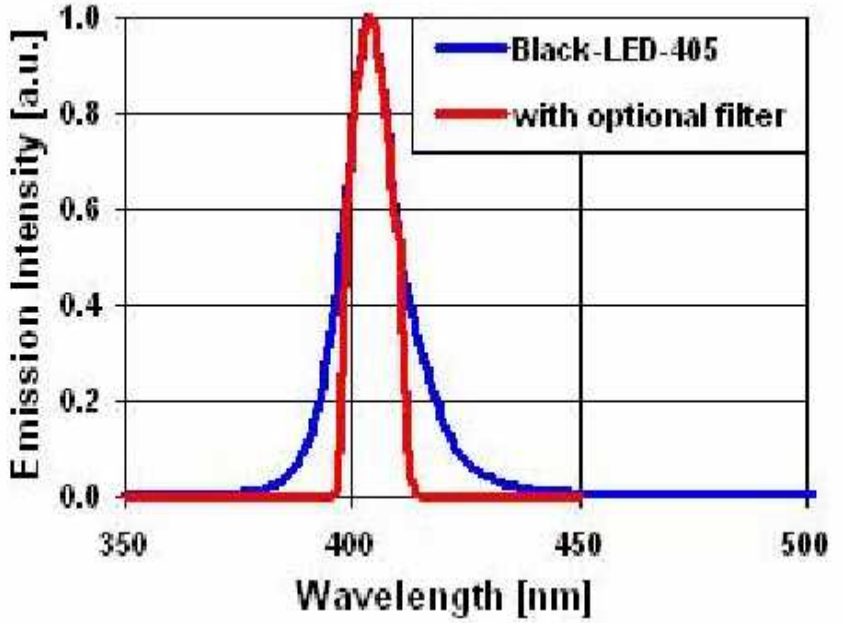
Courtesy J. W. Herrington, Ohio State University

Light sources can do all sorts of dangerous things

Safety

UV vs Blue Light (365nm vs 405nm)





Spectra of typical lamp sources

Safety

"The irreversible damage from the Bluelight to the retina is much worse than the reversible cornea photokeratitis ("Itching eyes") and the lens cataract mainly coursed by UVB (< 320 nm)"

Prof Alexander Allard, University of Uppsala, Sweden 2008

The important issue is that:

All wavelengths within the spectrum of 100 nm to 3000 nm have the potential to cause damage to the human organism. The topic itself is too complex to discuss in any detail. It is worth noting that the band from 365 nm to 405 nm appears to be the least injurious. However, all light sources should be considered potentially dangerous and appropriate PPE should be worn regardless of what wavelength is used.

Conclusions

Inorganic OAA's exhibit relatively large particle size: 5 - 10um (no mobility), are light stable, can have a choice of colours, are useful in a wide range of coating systems, and are more expensive.

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