The development of a 'smart-glass' filter for the purpose of blocking blue light from screens

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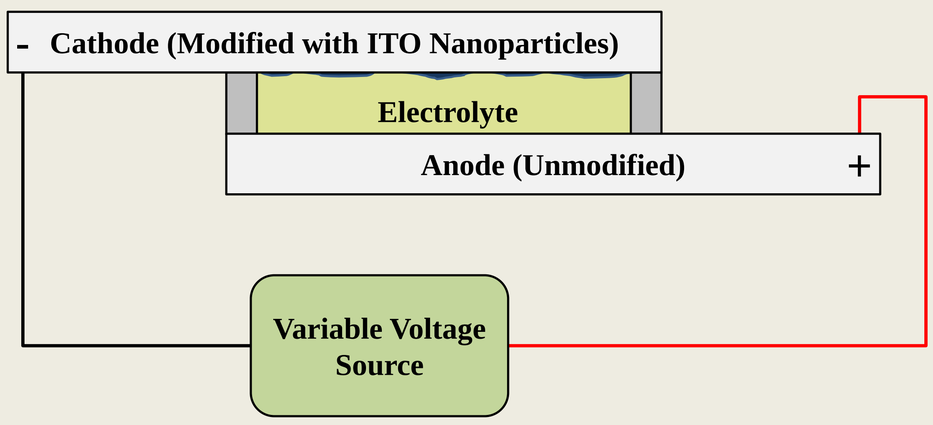
Introduction

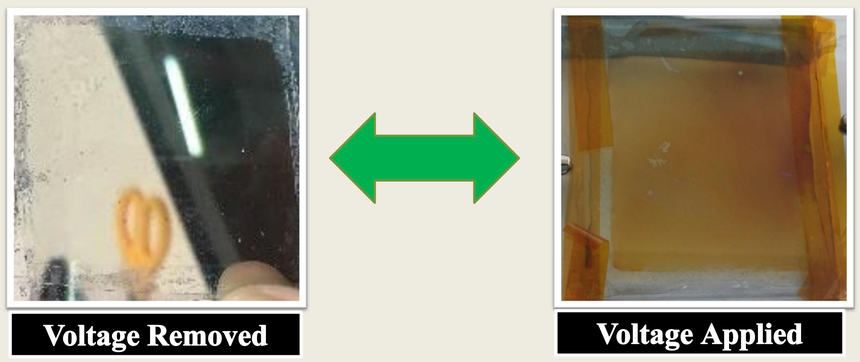
Do you often find it difficult to fall asleep or wake up? It may be due to the fact you are exposed to a lot of artificial light at night, resulting in the shifting of your body's circadian rhythm. Exposure to light when the sun has gone down suppresses the secretion of melatonin, a hormone which tells your body when it is day or night. As people are more sensitive to light of shorter wavelengths (blue light), by blocking light of only blue wavelengths, it would be possible to use your phones or computers at night, without having to worry about the effects it could otherwise have on your sleep.

Principle of Operation

In order to block blue light emitted from screens, the use of an electrochromic device is proposed which can display an orange tint, necessary to block light of blue wavelengths. This electrochromic device works on the principle of electrodeposition as shown below.



- When a potential difference is applied across the transparent electrodes, silver (Ag+) ions are deposited onto the cathode.
- The surface of the cathode is modified Indium doped Tin Oxide (ITO) nanoparticles, which results in the non-uniform deposition of silver ions.
- This leads to the absorption of light of certain wavelengths and transmission of others.
  - ➢ Device displays an orange tint as shown below.



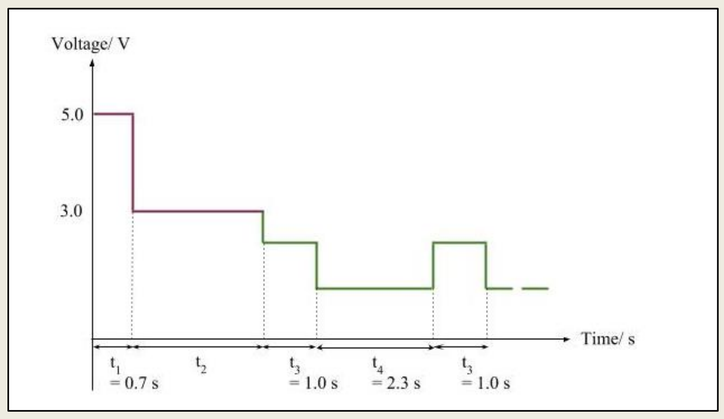
Voltage Removed | Voltage Applied

Methodology

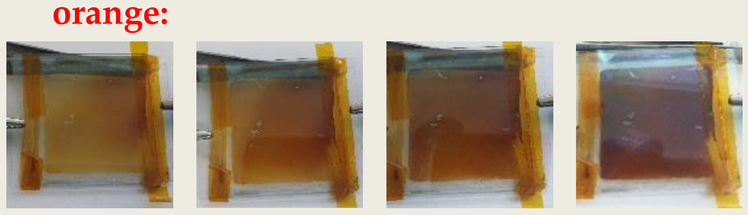
1. Preparation of electrolyte:

- 50 mM of silver nitrate (AgNO3)
- 250mM of lithium bromide (LiBr)
- 10mM of copper(II) chloride (CuCl2)
- Solvent: Dimethyl sulfoxide (DMSO)

2. Application of Voltage to device:



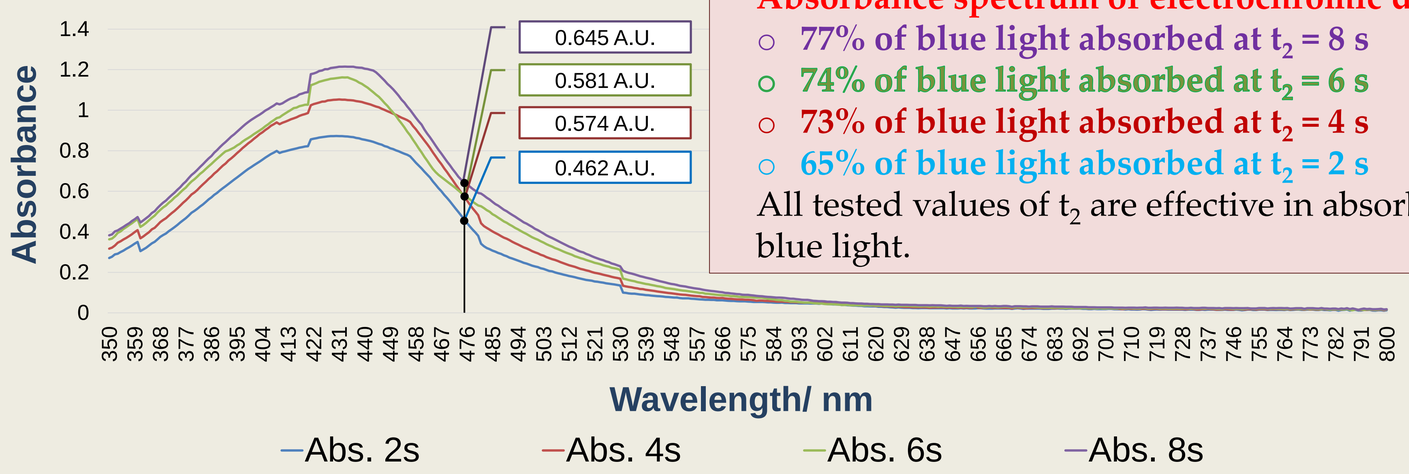
3. Varying t_2 to obtain different intensities of orange:



t_2 = 2 s | t_2 = 4 s | t_2 = 6 s | t_2 = 8 s

4. Measure absorbance spectrum with a spectrophotometer for all t_2.

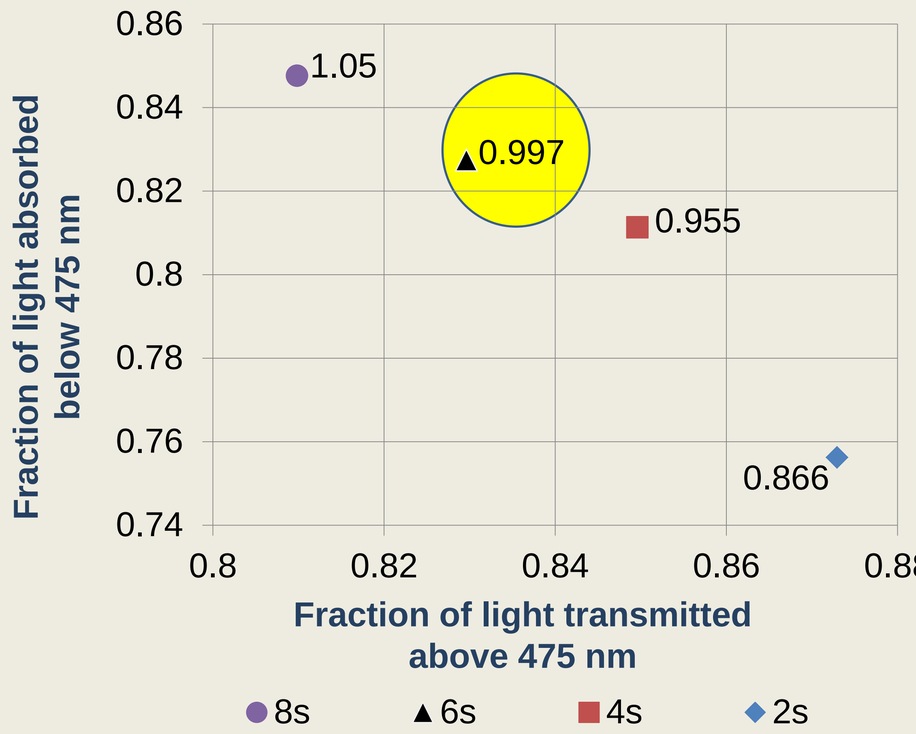
Results



Absorbance spectrum of electrochromic device:

- 77% of blue light absorbed at t_2 = 8 s
- 74% of blue light absorbed at t_2 = 6 s
- 73% of blue light absorbed at t_2 = 4 s
- 65% of blue light absorbed at t_2 = 2 s

All tested values of t_2 are effective in absorbing blue light.



Determining most effective value of t_2:

1. The graph of the fraction of light absorbed below 475 nm (blue light) is plotted against the fraction of light transmitted above 475 nm.
2. The ratio of these is then obtained.
3. Since when t_2 = 6 s, the ratio is (0.997), the closest to 1.0, it suggests that the device is the most effective in blocking blue light without affecting the other wavelengths of light at this value of t_2.

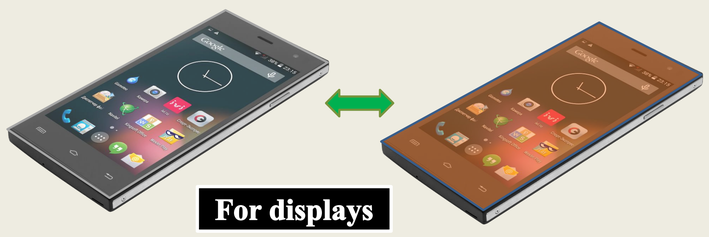
Discussion

Current Limitations:

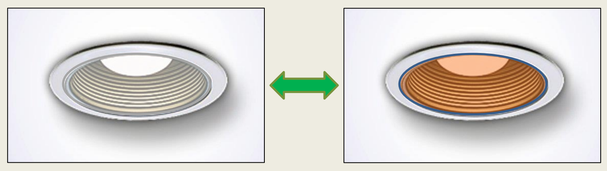
- Device is too thick → Usage of thin conductive plastic sheets is possible.
- Too few sets of data → Experimentation with other voltages and timings are needed.
- Preparation of device is cumbersome → It could be improved with the use of a gel electrolyte.

Possible Applications:

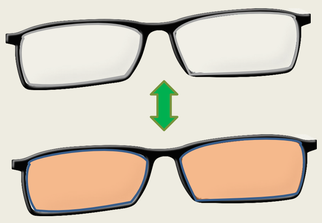
- Screen Protector/ Case (Displays)
- Ceiling Lights/ Lamps
- Smart Prescription/ Sun Glasses



For displays



For ceiling lights/ lamps



For eyewear

Advantages:

- Controllable (through application of Voltage)
- Effective (74% of blue light absorbed)

Future Work:

- Investigate other nanoparticles on effectiveness of the device and as a replacement for ITO given its high cost.
- Conduct studies on the effect of sleeping patterns of people who use the filter.
- Compare the effectiveness of the filter against current solutions in the market (eg. Blue light glasses, f.lux).