SOLUTION PHASE EC DEVICES WITH NEAR INFRARED ATTENUATION

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Solution phase organic electrocrochromic (EC) materials have found wide acceptance in EC mirrors for automobiles, due in part to their intense visible light absorbance. In fact most devices are designed to attenuate only the visible portion of the spectrum. Solution phase organic materials have not been generally viewed as useful in EC windows, in part because near infrared (NIR) attenuation has not been demonstrated. We have found organic materials that when used in solution phase organic EC windows demonstrate strong NIR absorbance.[1] Use of these materials in EC devices has shown enhanced solar performance.

Windows made with NIR absorbing anodic EC materials are shown to have total solar attenuation of greater that 5 to 1 compared to approximately 2 to 1 for a window with visible light absorbing EC materials. Figure 1 shows curves that represent the solar radiation transmitted as a function of wavelength of EC window (ECW1) using solution-phase organic materials which do not exhibit NIR activity, in its high transmittance state and in its low transmittance state, while Figure 2 curves that represent the solar radiation transmitted as a function of wavelength of EC window (ECW2) with NIR absorbing materials. Table 1 gives the total solar, UV, visible and NIR percent transmission values for the device depicted in Figure 1 while Table 2 gives the same values for the device from Figure 2.

We have also found that for anodic materials that undergo 1 electron oxidation, evaluation of the orbital energy difference between the singly occupied molecular orbital and the highest doubly occupied orbital coupled with the orientation of the transition dipole moment (the diagonal matrix elements of the outer product of the orbitals times the position of the associated atomic center) serves as a useful selection rule to determine the NIR activity of anodic EC materials. We have also found that the proper bridging of two anodic monomers can results in an coupled electrochromic compound that has spectral properties that differ from the parent monomer, which may include absorbance in the NIR.[2]

1 Theiste, D., et. al., US Patent # 6193912
2 Theiste, D., et. al., US Patent # 6249369

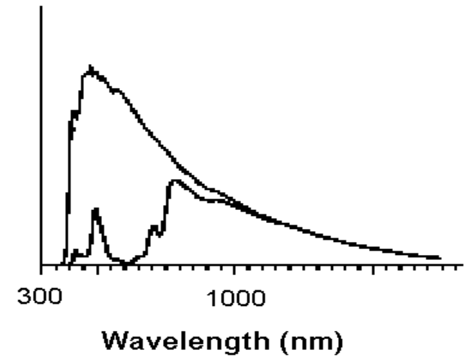

Figure 1. Solar radiation transmitted through ECW1 in the high and low transmittance state.

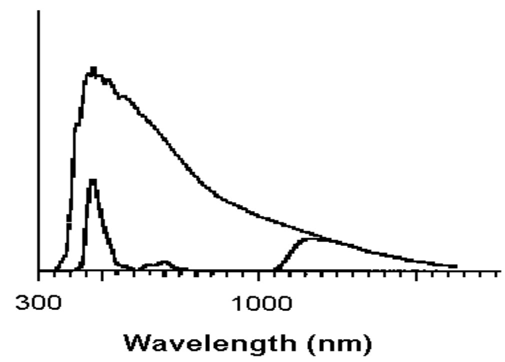

Figure 2. Solar radiation transmitted through ECW2 in the high and low transmittance state.

Spectral Region	%Transmission in Clear State	%Transmission in Dark State
UV	7.6	0.0
Visible	74.5	8.9
NIR	55.4	50.0
Total Solar	60.3	27.4

Table 1. Percent transmittance of solar energy in Various spectral region for ECW1.

Spectral Region	%Transmission in Clear State	%Transmission in Dark State
UV	5.8	0.0
Visible	73.8	8.4
NIR	46.2	13.6
Total Solar	55.6	10.2

Table 2. Percent transmittance of solar energy in Various spectral region for ECW2.