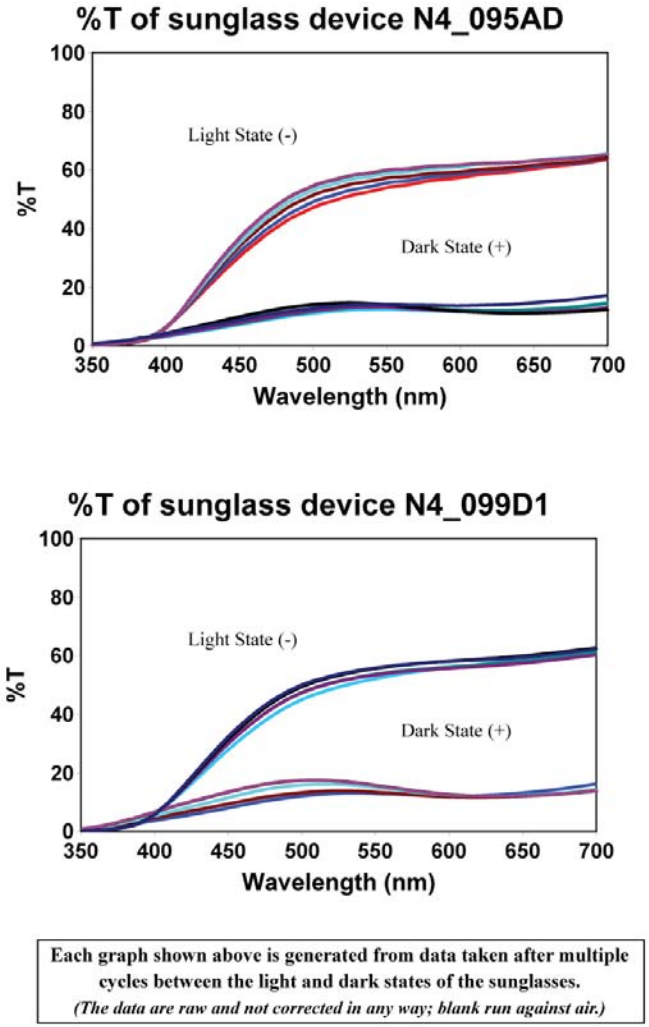


Figure 23.1 "In-situ" UV-Vis-NIR spectra of an electrochromic device based on a poly(diphenyl amine) derivative. Light and dark states are clearly contrasted. The several spectra indicate repeated cycling between light and dark states.

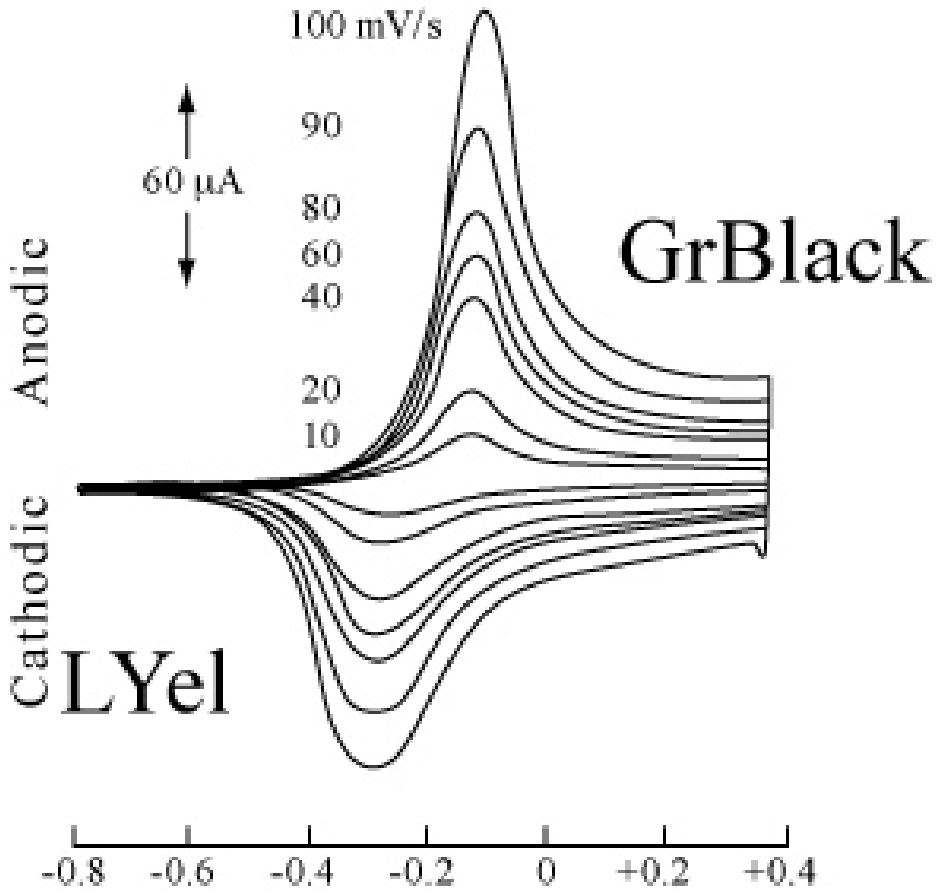


Figure 23.2 ***Cyclic Voltammograms (CVs) of Poly(pyrrole)BF_4 as function of scan rate, with color change also shown. Reproduced with permission from ref. [4].***

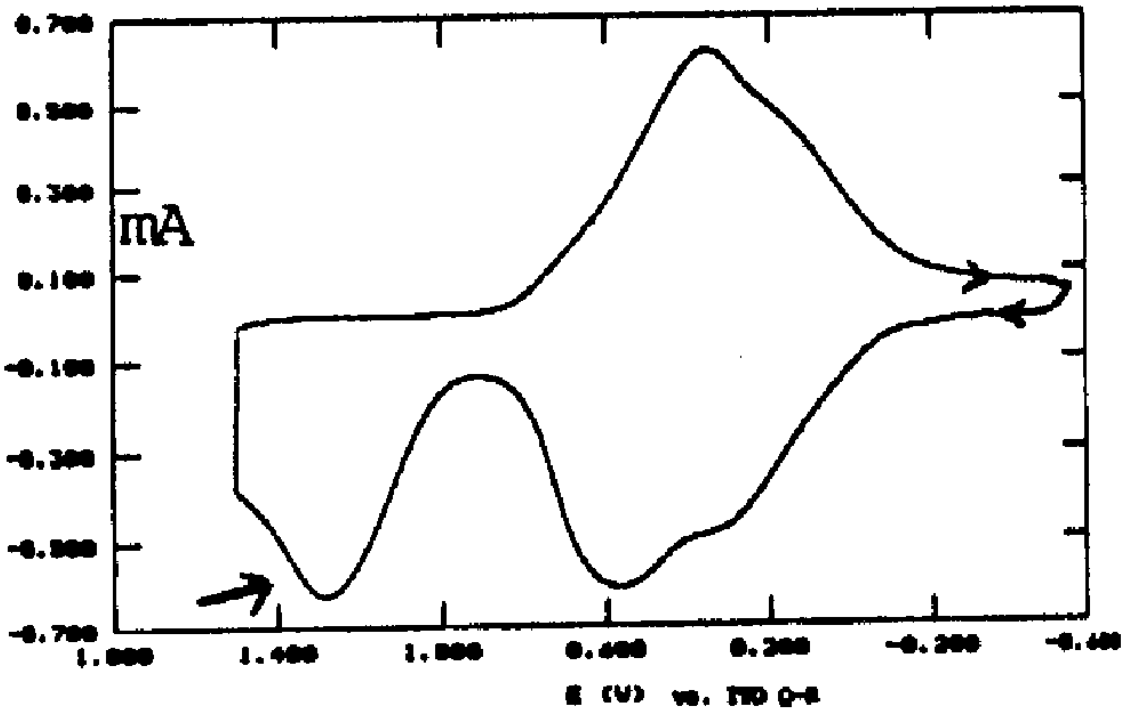


Figure 23.3 CV of poly(diphenyl amine) derivative, showing oxidative decomposition peak (arrow). [Courtesy of Ashwin-Ushas Corp., Inc.].

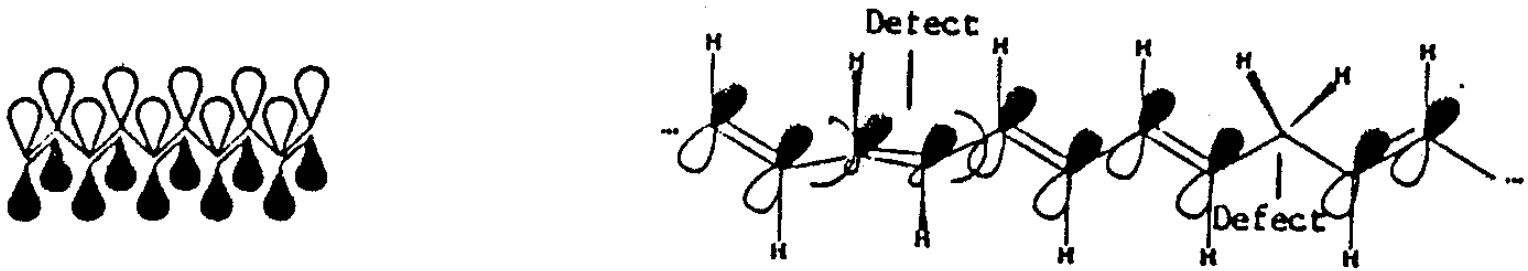
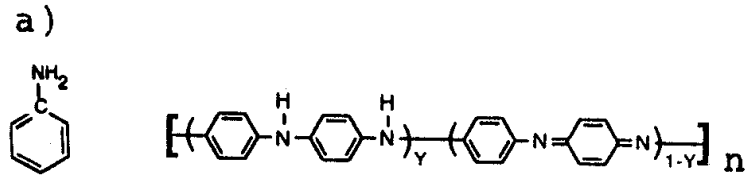
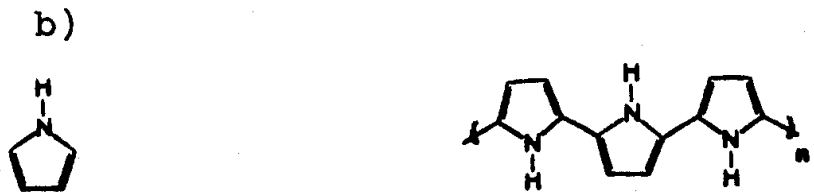


Figure 23.4 ***Schematic representation of Pi-conjugation in the CP poly(acetylene). <u>Left</u>: Basic schematic. <u>Right</u>: 3-dimensional, including defects.***

a) Poly(aniline) (P(ANi))



b) Poly(pyrrole) (P(Py))



c) Poly(thiophenes)

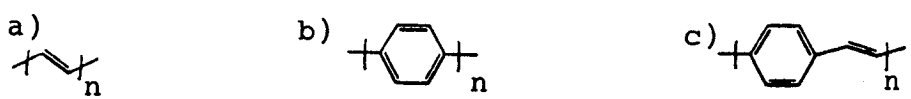
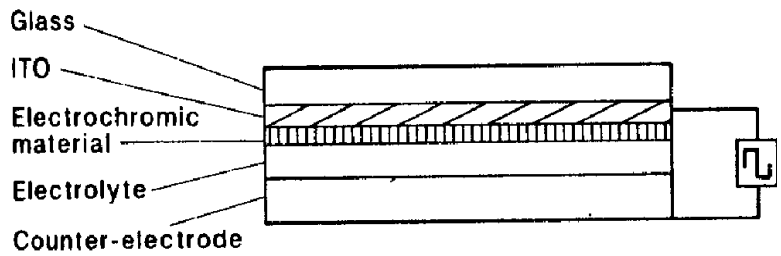


Figure 23.5 ***<u>Top</u>: Schematic illustration of monomer unit (left) and CP (right) for three common CPs: a) Poly(aniline) (P(ANi)); b) Poly(pyrrole) (P(Py)); and c) Poly(thiophenes).***
<u>Bottom</u>: Schematic structures of three common CPs: a) Poly(acetylene); b) Poly(p-phenylene); c) Poly(p-phenylene-vinylene)



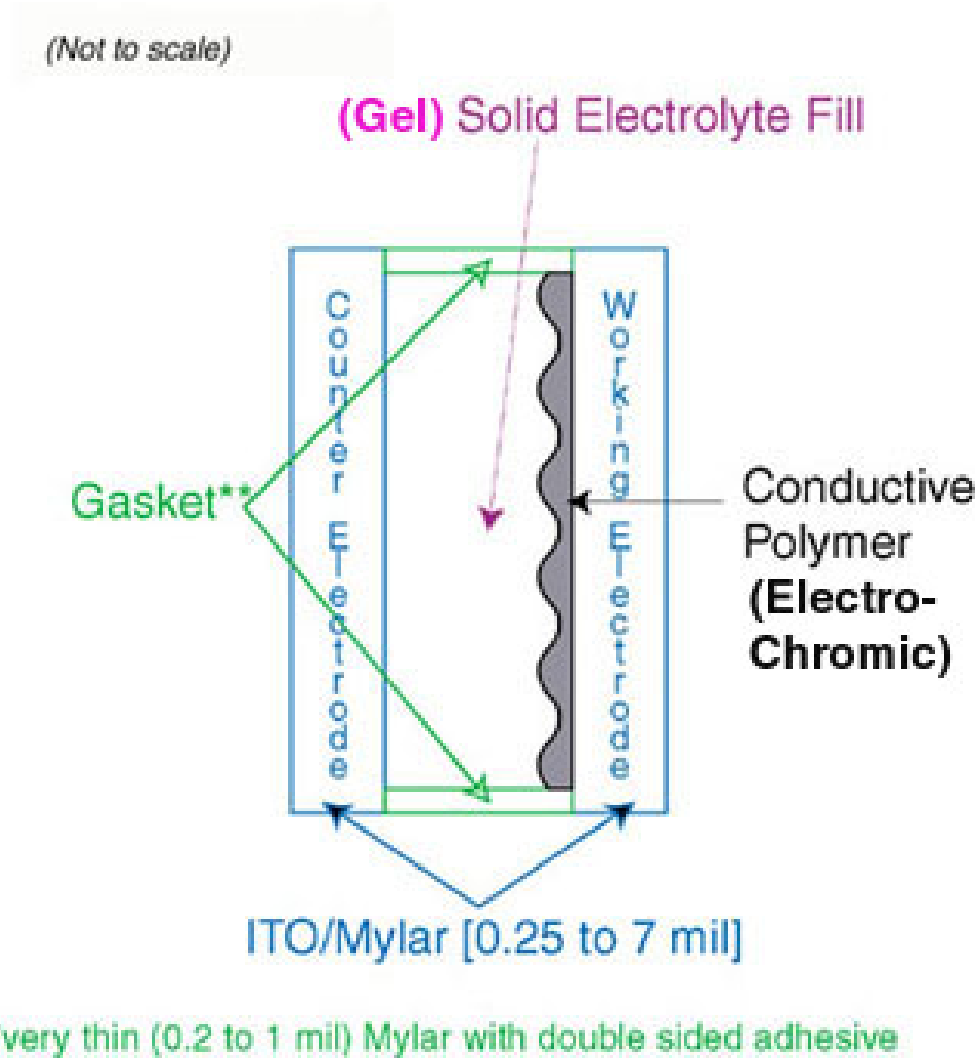


Figure 23.6 ***<u>Top</u>: Schematic of typical <u>transmission</u>-mode electrochromic device. After Reference [12], reproduced with permission.***
<u>Bottom</u>: Schematic of a more recent transmission-mode electrochromic device. [Courtesy of Ashwin-Ushas Corp., Inc.].

Figure 7, Bottom (Top on next page)

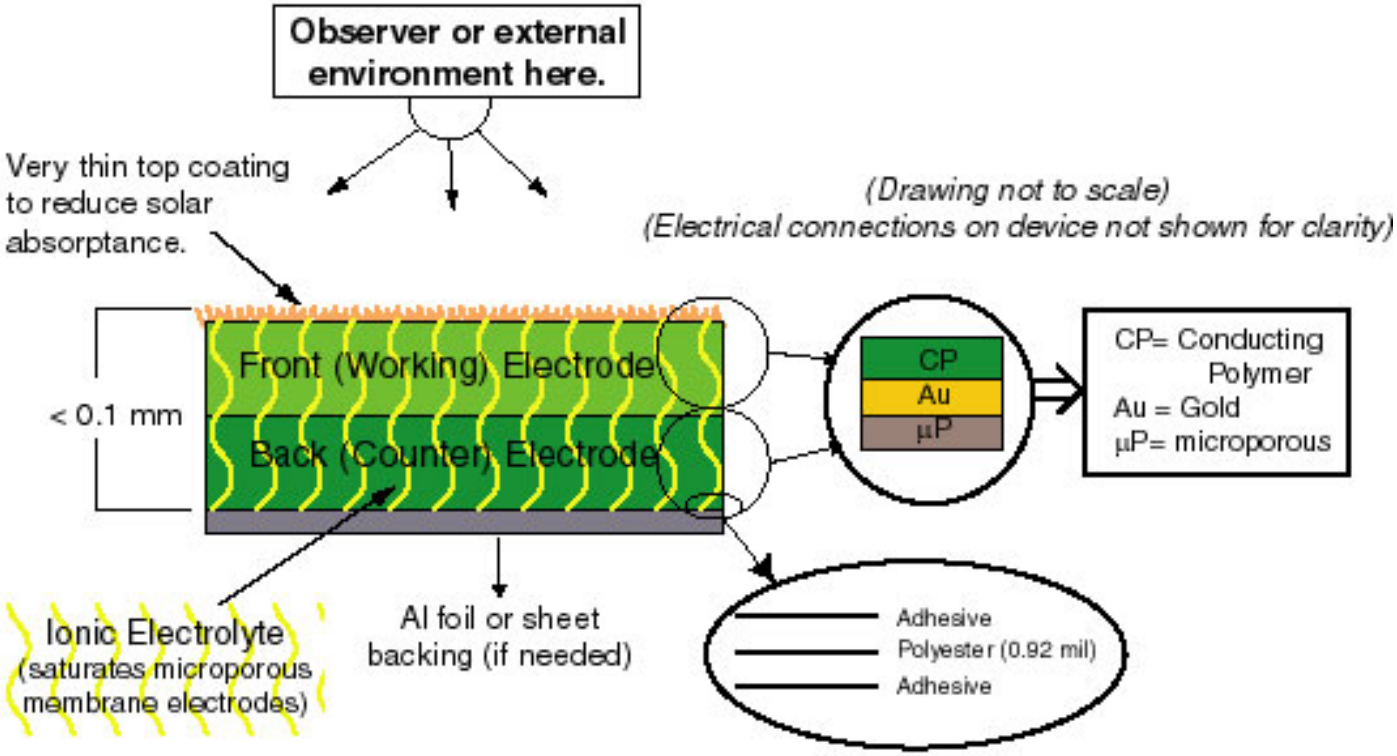
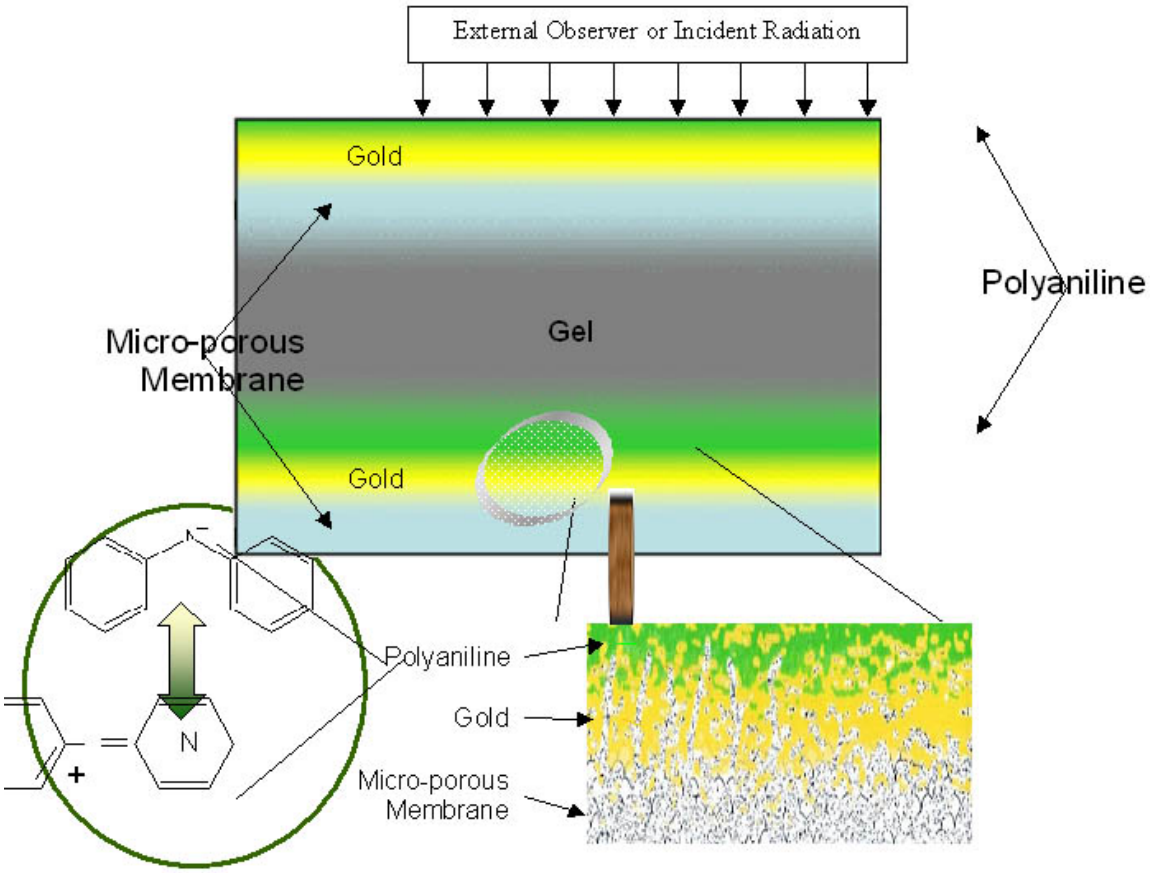


Figure 23.7 (Top): (i) Schematic of a Reflectance-mode electrochromic device, here using a single microporous membrane with Au deposited on both sides serving as the working and counter electrodes. The electrochromic material used is poly(aniline).
(Bottom): A similar reflectance-mode device, also using microporous membranes, but now with two membranes, one each for the working and counter electrodes, and with other modifications such as ionic electrolytes, suitable for use in spacecraft.[Courtesy of Ashwin-Ushas Corp., Inc.]

Figure 7 ***(Top)***


External Observer or Incident Radiation
Gold
Gel
Gold
Micro-porous
Membrane
Polyaniline
Polyaniline
Gold
Micro-porous
Membrane
N
+

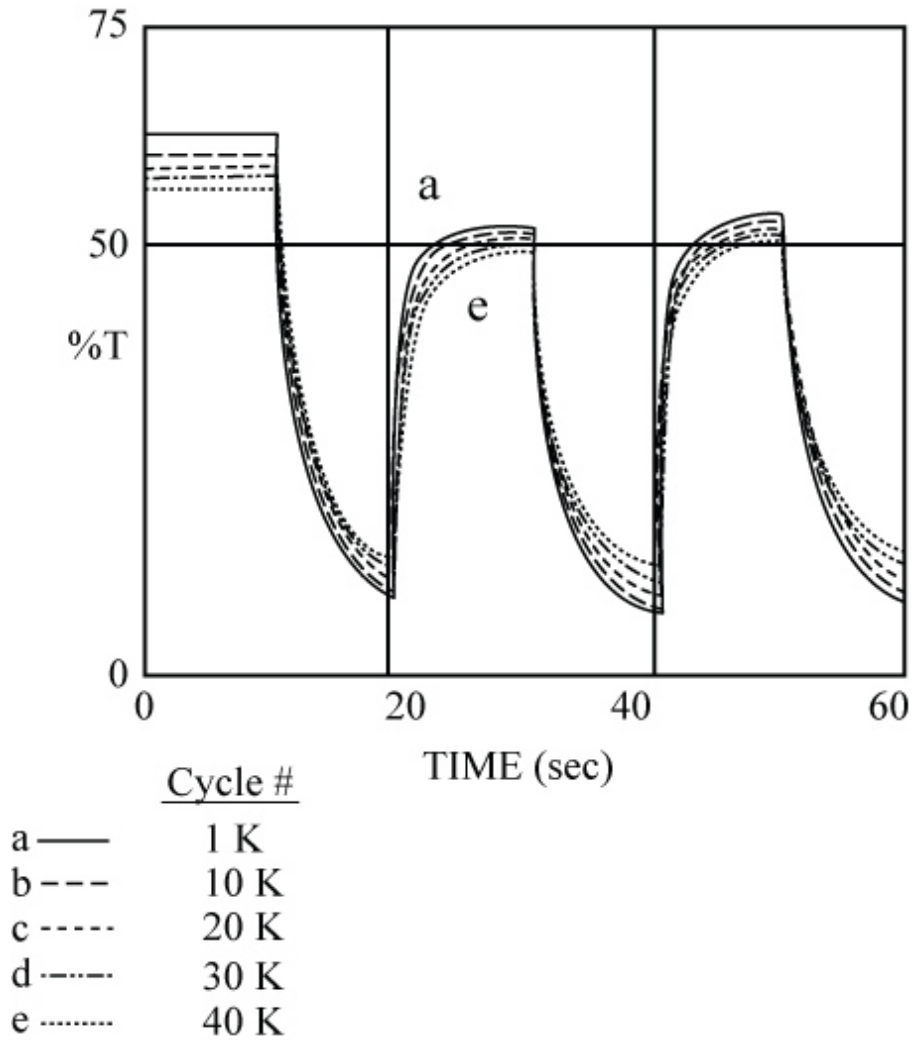


Figure 23.8 ***Typical Chronovoltabsorptometry (CVA) data for a poly(aromatic amine). Cycle numbers are indicated. [Courtesy of Ashwin-Ushas Corp., Inc.]***

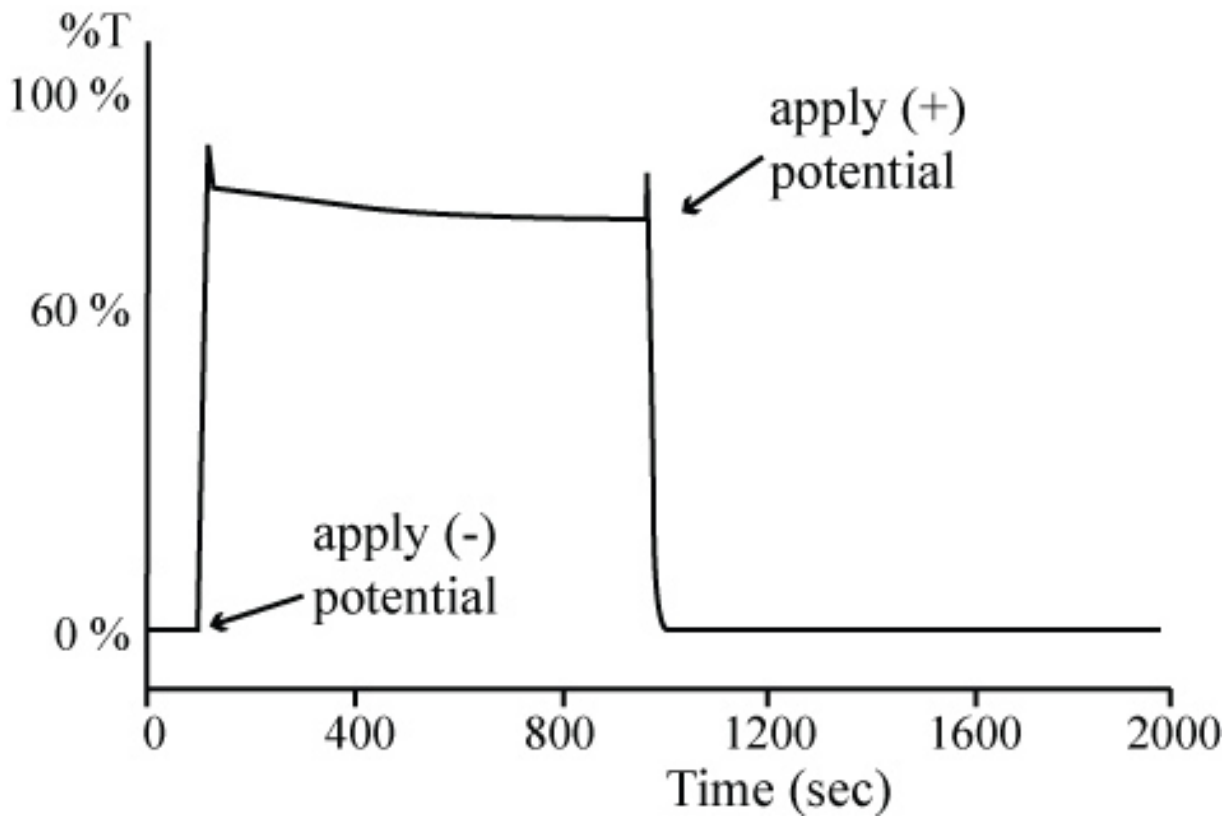


Figure 23.9 Open Circuit Memory data for a poly(aromatic amine)/sulfonate system (sealed electrochromic device). At each arrow, the reducing/oxidizing potential is applied for 60 seconds, and the cell then disconnected. [Courtesy of Ashwin-Ushas Corp., Inc.]

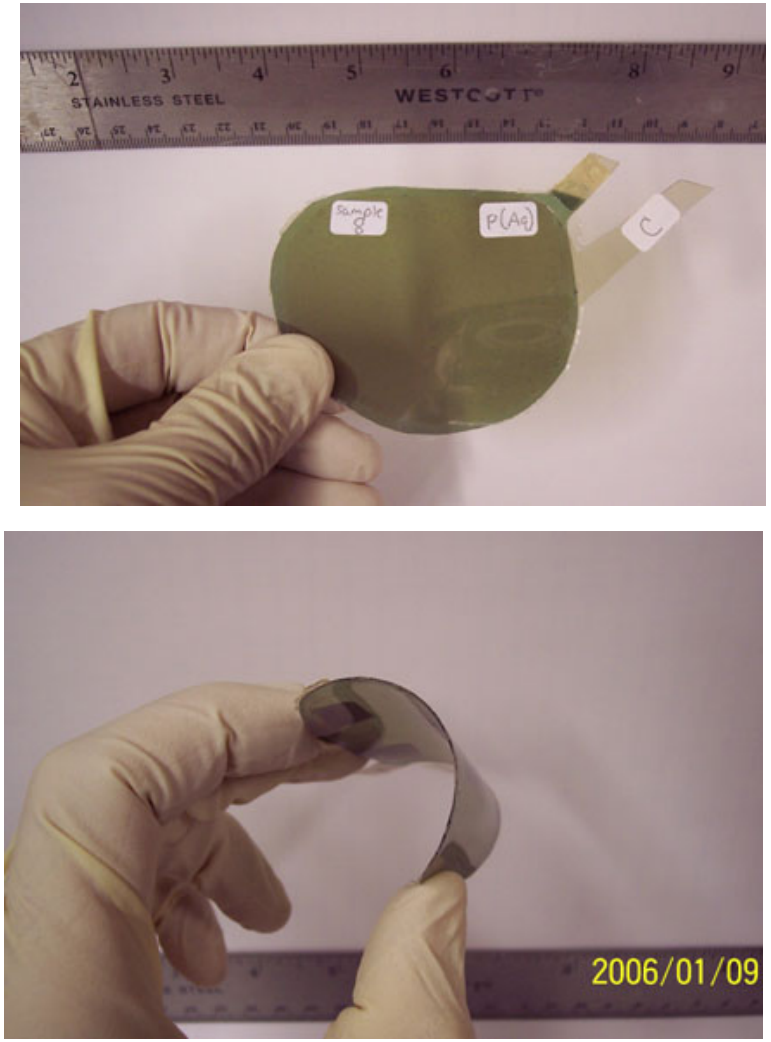
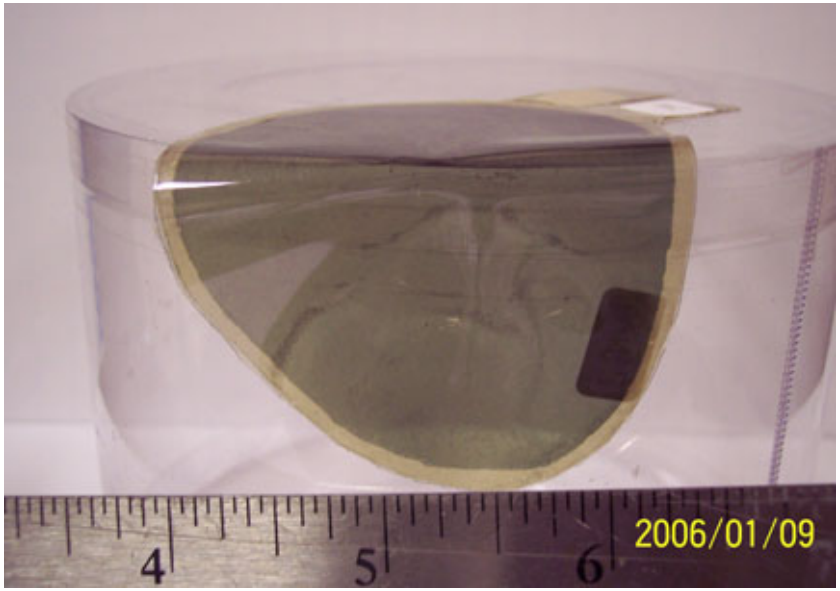


Figure 23.10 (Top to Bottom): Photos of Transmission-mode, Visible-region electrochromic devices, having the construction shown in the schematic of Figure 6. Photos show eyeglass shape suitable for sunglasses application, high flexibility, and capability of being affixed to substrates of varied shapes using pressure sensitive adhesive. [Courtesy of Ashwin-Ushas Corp., Inc.]

Figure 10, cont.



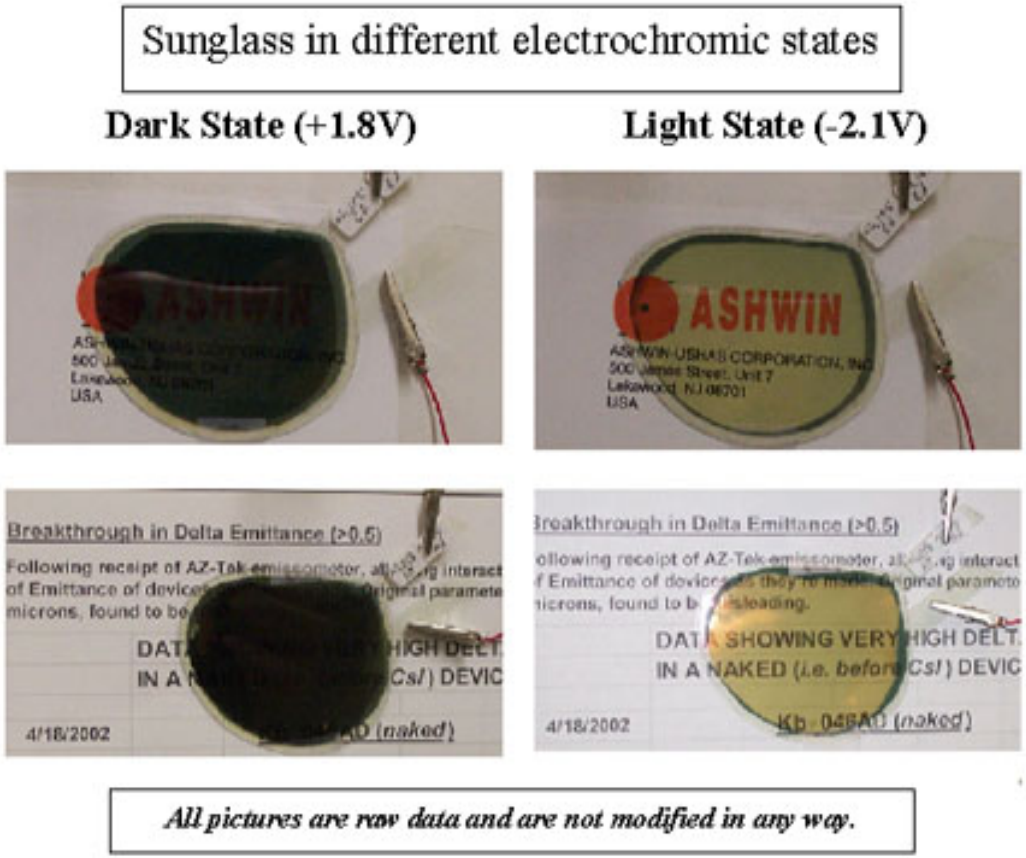


Figure 23.11 (Top to Bottom): Photos of sunglasses devices of Figure 10 in dark and light state, indoors (top) and outdoors (middle), showing excellent color contrast (dynamic range). (Bottom)- Actual electrochromic performance (spectroelectrochemical data) for these devices, again showing excellent dynamic range and broad-band (500 to 900 nm) nature of electrochromism.[Courtesy of Ashwin-Ushas Corp., Inc.]

Figure 11, cont.

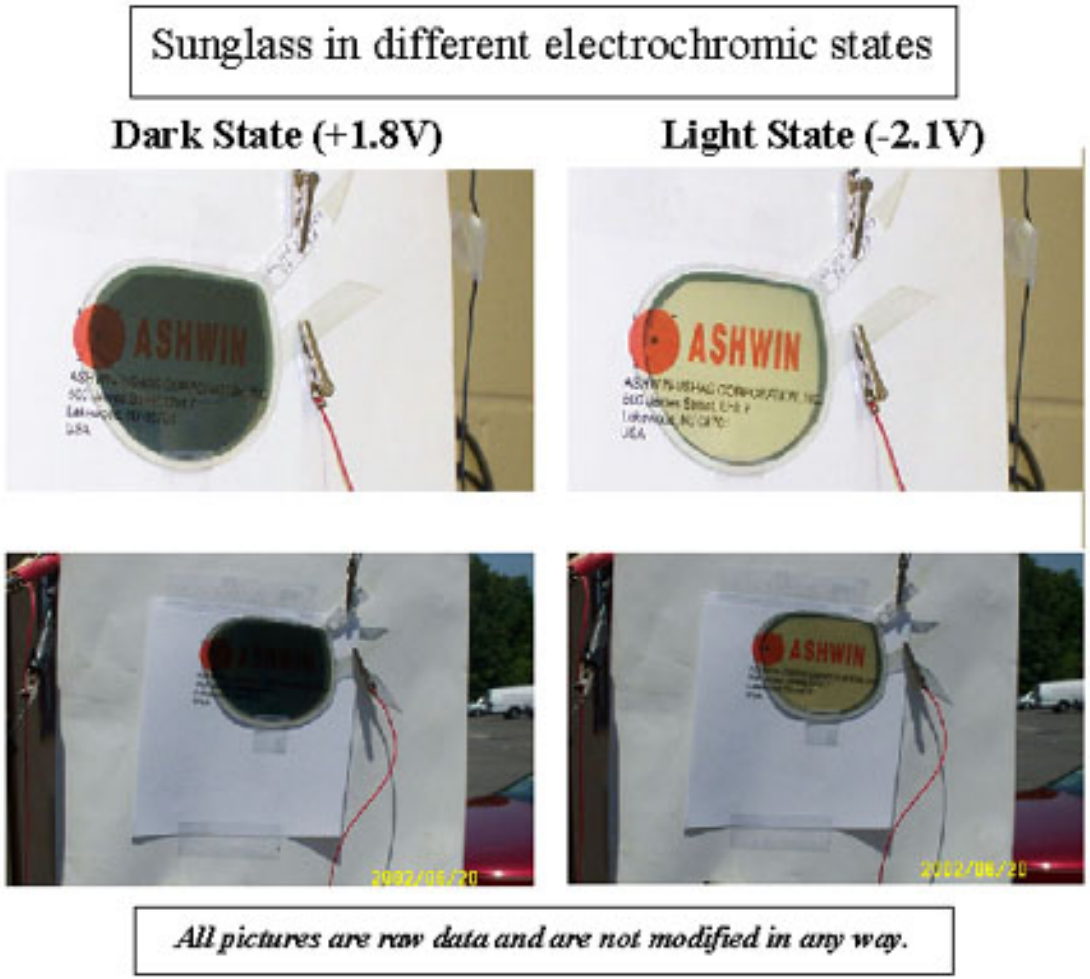
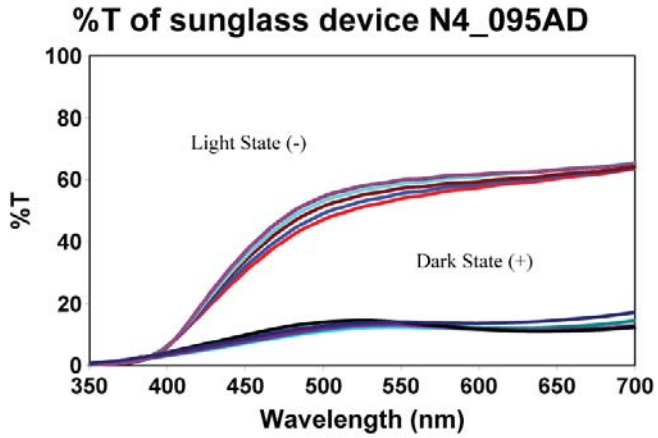
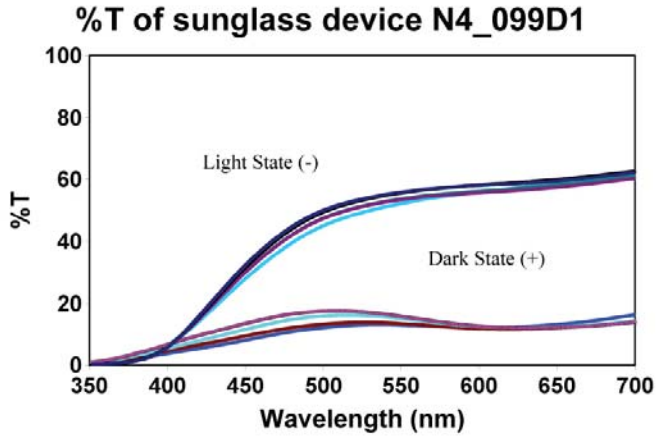
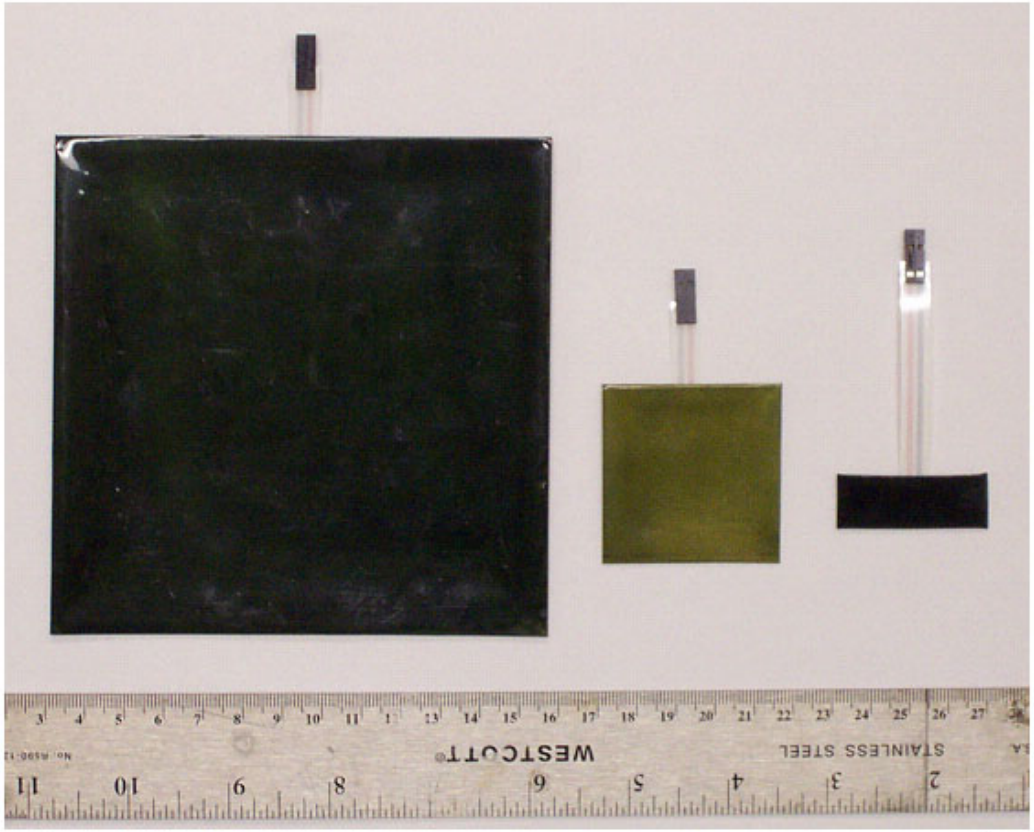


Figure 11, cont.





Each graph shown above is generated from data taken after multiple cycles between the light and dark states of the sunglasses.
(The data are raw and not corrected in any way; blank run against air.)

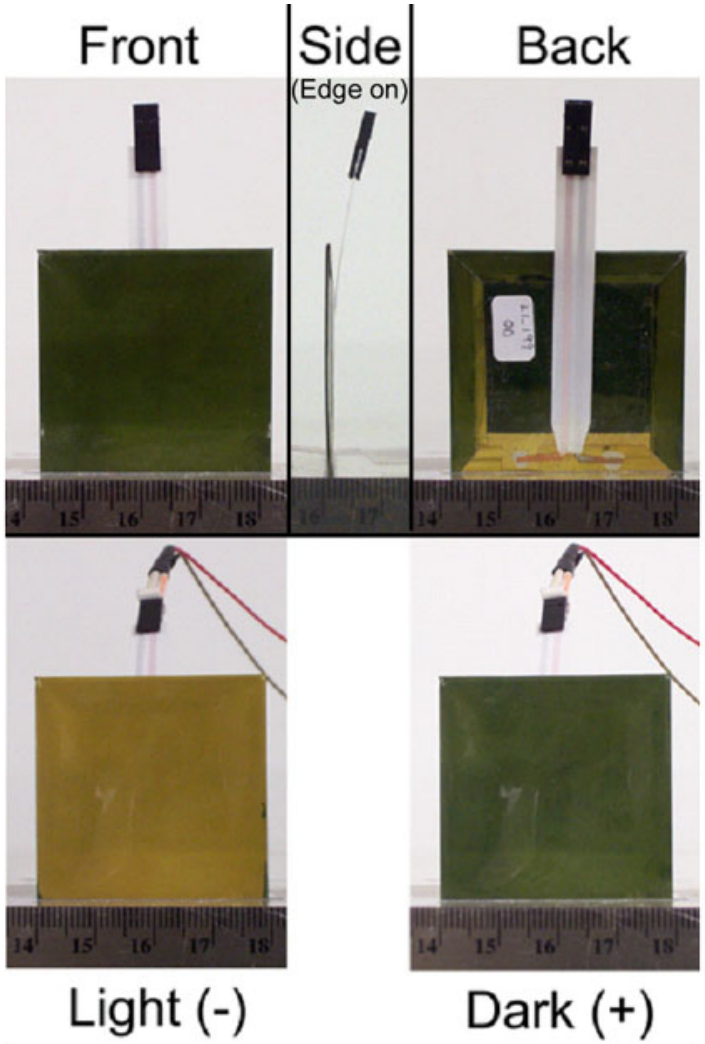


Devices can be customized in shape and size to fit your application.

(All pictures are raw data and are not modified in any way.)

Figure 23.12 Photos of typical Reflectance-mode, IR-region electrochromics, of the construction shown in Figure 7. [Courtesy of Ashwin-Ushas Corp., Inc.]

Figure 12, cont.



Top row: View of a device from the front, side and back.
Bottom row: Color change shown for a typical device.
(All pictures are raw data and are not modified in any way.)

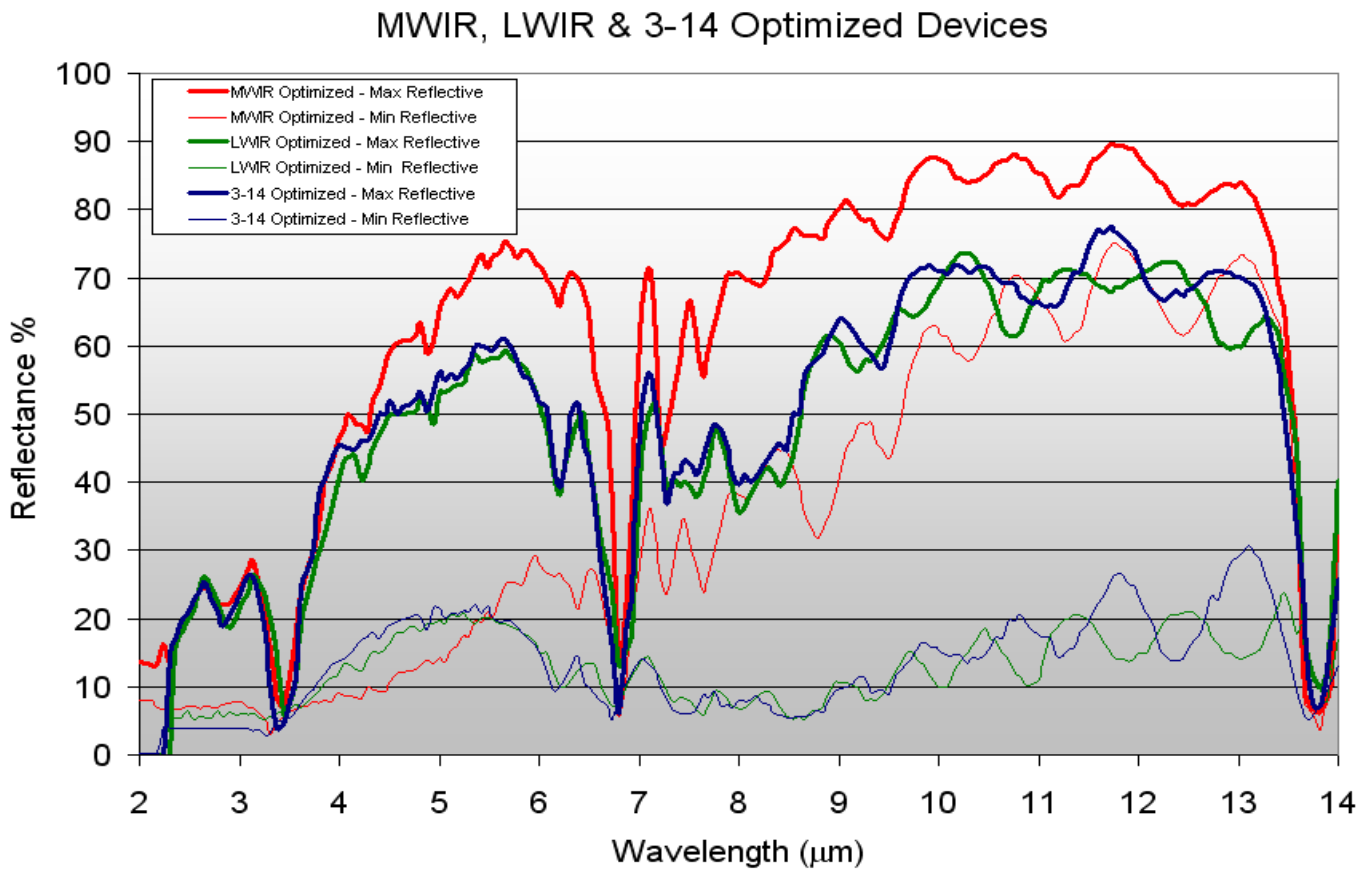


Figure 23.13 Electrochromic performance of IR devices of the type shown in Figure 12. The data are for three separate devices, optimized, as noted in the figure, respectively for the mid-IR (MWIR), far-IR (LWIR), and 3 to 14 :m regions. For each device, the reflective-state ("light-state") and absorptive-state ("dark-state") spectra are shown. The dynamic range between these states is seen to be very large. [Courtesy of Ashwin-Ushas Corp., Inc.]