3.4 Green

3.4.1 Chromium Oxide Green, Modified Chromium Oxide Green

Chromium oxide green Cr_2O_3 (**G01 - G02**) exhibits strong scattering alternating with strong absorption across the visible spectrum, and strong scattering and mild absorption in the NIR. Since the pigment is almost opaque in the visible, a thin layer of chromium oxide green over a white background yields a medium-green coating with good NIR reflectance (0.57 for 13-μm thick film G02). The modified chromium oxide green (**G03**) is mostly chromium oxide, with small amounts of iron oxide, titanium dioxide, and aluminum oxide [16]. A layer of the modified chromium oxide green over a white background produces a medium green with excellent NIR reflectance (0.71).

Cr_2O_3 green is often mentioned as an infrared-reflective pigment that is useful for simulating the high infrared reflectance of plant leaves. Indeed, a high NIR reflectance is observed. However, our data for sample films G01 and G02 do show that there is a broadband absorption of about 10 mm^{-1} in the near-infrared. While our measurements of absorptance coefficient are not precise for low absorptances, this value is clearly distinct from zero. Pure Cr_2O_3, fired in air, tends to become slightly rich in oxygen, which results in p-type semiconducting behavior [23, 24]. Thus it is possible that the broadband IR absorption of Cr_2O_3 is due to free carrier absorption by mobile holes. Ref. [23] also reports that doping with Al can reduce the p-type conductivity in Cr_2O_3, so it seems likely that doping with Al and/or certain other metals can also reduce the IR absorption.

The modified chromium oxide green G03 is similar to G01 and G02 Cr_2O_3. However its green reflectance peak at 550 nm is somewhat smaller and its infrared absorption is clearly much smaller than those of samples G01 and G02.

3.4.2 Cobalt Chromite Green

Cobalt chromite green (**G04 - G06**) is similar to cobalt chromite blue, and is commonly used for military camouflage.

3.4.3 Cobalt Titanate Green

Cobalt titanate green (**G07 - G09**) is similar to cobalt chromite green, but scatters more strongly across the entire solar spectrum and has a pronounced absorption trough around 500 nm. A white background makes cobalt teal G07 very NIR reflective (0.73) but also appear light blue (hence, the name teal). The other two cobalt titanate greens (G08, G09) have respectable NIR reflectances (0.47, 0.37) over white and appear medium green.

3.4.4 Phthalocyanine Green

Phthalocyanine green (**G10 - G11**) is similar to phthalocyanine blue, but absorbs more strongly in the short NIR. Hence, the NIR reflectance of a thin phthalo green film over white, while respectable, is only 70% of that achieved by a thin layer of phthalo blue over white (0.45 for G10 vs. 0.63 for U12). Note also that the error in predicted reflectance over white for G11 is large, as discussed in the companion article [1].

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