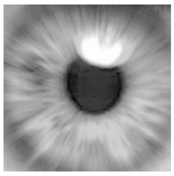

Dominant Wavelength and Purity

Dominant wavelength

Optical filters, LED's and other light sources can be characterized by their dominant wavelength, λ_d and either the colorimetric purity, p_c or the excitation purity, p_e. The concept is most useful for saturated colours or narrow banded light sources. For broad banded light sources (white light) the concept of correlated colour temperature, T_{cp} is more meaningful.

The dominant wavelength (of a colour stimulus) is defined as: "the wavelength of the monochromatic stimulus that, when additively mixed in suitable proportions with the specified achromatic stimulus, matches the colour stimulus considered".

One of the properties of CIE 1931 chromatic system is that the chromatic coordinates of an additive mixture of two stimuli and of the two stimuli will belong to the same straight line. Hence finding the dominant wavelength of a stimulus is a simple geometrical problem. In figure 1 is shown an example concerning a green LED.

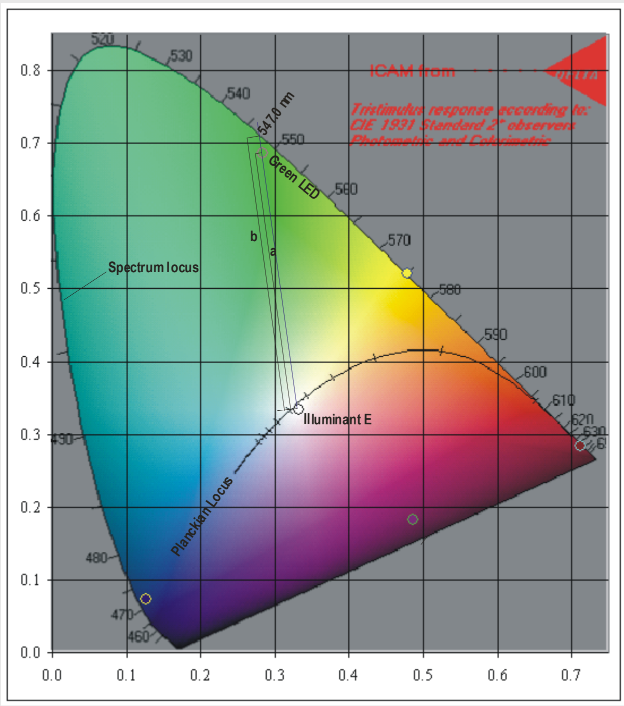

Figure 1. Definition of dominant wavelength and purity.

An example

A colorimetric measurement supplied the chromatic coordinates of the green LED to x = 0.2835 and y = 0.6870. The achromatic stimulus is, in this example, the CIE standard illuminant E with x = y = 0.3333. By plotting the two points in the CIE 1931diagram and drawing the line from the achromatic source through the green LED until intersection (x = 0.2801 and y = 0.7117) with the spectrum locus the dominant wavelength is read to 547.0 nm. See figure 1.

Colour purity

The quantity, excitation purity, p_e is defined by the ratio a / b, where 'a' is the distance between the point representing the stimuli in question and the point representing the achromatic stimuli, and 'b' is the distance between the point representing the achromatic stimuli and the point on the spectrum locus where the dominant wavelength is read.

The quantity, colorimetric purity, pc is defined by the ratio Ld / (Ld + Ln), where Ld is the luminance of the monochromatic stimulus and Ln is the luminance of achromatic stimulus that, in a mixture, match the colour stimulus considered.

In the CIE 1931 system this relationship between p_e and p_c holds: $p_c = p_e \times y_d/y$, where y_d and y are the y-chromaticity coordinates of the monochromatic stimulus and the colour stimulus considered.

An example

From the coordinates in the last example the excitation purity, pe, is found to pe = 0.3572/ 0.38212 = 0.935. From this we can calculate pc = pe × 0.7117 / 0.6870 = 0.968.

The wavelength range, where the dominant wavelength can be calculated, is from 360 nm to 700 nm. Monochromatic light from 700 nm to 830 nm all have the same chromatic coordinates. An achromatic stimulus will have a purity of 0.0 while monochromatic stimuli will have s purity of 1.0.

Note: *All definitions are taken from CIE 15:2004, Technical report on Colorimetry.*

DELTA · Venlighedsvej 4 · 2970 Hørsholm
Tel. (+45) 72 19 40 00 · Fax (+45) 72 19 40 01
E-mail: icam@delta.dk · Also visit www.delta.dk