A white–cyan-red LED system for low correlated colour temperature lighting

A white LED complemented by cyan and red LEDs is a good candidate for achieving high colour rendering at low correlated colour temperatures. This is usually very difficult with commercially available white LEDs. In addition, the system is able to replace incandescent lighting in many applications; for example, the lighting for museum display cases. To investigate and optimize the colour and light distribution properties, both spectral and geometrical modelling are used. Mapping of the possible combinations of LEDs is used to locate the optimal solutions within the colour gamut, with emphasis on chromaticity and colour rendering indices. A geometric optical model is used to design and optimize the homogeneity of the colour and light intensity distribution as a function of angle. The resulting system produces diffused homogeneous white light with a tunable correlated colour temperature from 2000 K to 2400 K. Within this range the white light is characterized by a high general colour rendering index ($R_g > 90$), special colour rendering indices for saturated red objects ($R_9 > 85$), and low chromaticity distance ($D_{uv}$) from the Planckian locus ($D_{uv} < 2 \times 10^{-3}$).

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