ABSTRACT

Solid-state lighting is the lucrative choice while envisioning a light source which is energy efficient, eco-friendly, long life time, color tunable, dynamic illuminance and cost saving. Albeit conventional lamps are widely used their inefficiency has been recognised. The research on light and health has shown the significant positive impact of light on health and entrainment of circadian rhythm. In pursuit of enhancing the color quality of light which focus on visual and non-visual effects of light, this research work concentrated to tailor the tunability of the correlated color temperature and illuminance to mimic the natural course of daylight. The pilot study on color renderance of di-chromatic, trichromatic, tetra-chromatic, quanti-chromatic LED is expanded to build a multichip hexachromatic LED luminaire comprising of red-green-blue-amber-cool white-neutral white to deliver color rendering index greater than 90 at all correlated color temperature 2700K-6500K and illuminance 50-1200 lux. Osram color simulator analysed the color difference less than 10 for the designed luminaire on Munsell 15 color samples. Further locus of the test lamp maps close to the reference lamp in color space CIELab, thereby ascertaining the high color quality and performance of designed luminaire. The attributes such as circadian action factor and Melatonin suppression assay the circadian effects of the designed light source. The circadian action factor quantifies the blue enrichment in white light. The designed multichip polychromatic luminaire has a circadian action factor of 3.9 which showed 70% Melatonin suppression using Rea et al. human phototransduction model. Further, the luminaire was tested for structural similarity index of the object illuminated by it which scored 0.996 similar to the conventional CFL lamp. These results enumerate the designed luminaire aid in the entrainment of circadian rhythm meeting the advancement and current challenges in the lighting industry to build a multichip polychromatic LED luminaire enriched with visual and circadian benefits to the society.