Thermoresponsive PDLC coating in smart LED application

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Driven by advances in R&D and in light-emitting diodes (LEDs), the lighting industry is expected to shift towards intelligent lighting systems in the coming years. Controlling the correlated color temperature (CCT), from warm white light to cold white light, or vice versa, has attracted attention [1][2]. Most systems known use multiple LEDs for controlling the CCT. In this paper we present a novel single LED system that changes CCT with increasing temperature, using the heat produced by the LED as trigger for this thermoresponsive system.

Presented in this manuscript is a thermoresponsive Polymer Dispersed Liquid Crystalline (PDLC) coating comprising a polysiloxane based liquid crystal (LC) material and an acrylate matrix; the coating is applied on top of a top-emitting LED. At low temperature the LC material is in the smectic phase, affording a light scattering coating. At temperatures above the clearing point of the LC, the coating is transparent. In the scattering state the LED light is scattered back to the LED, where the blue LED-emitted light can be absorbed and re-emitted by the phosphor, facilitating blue-to-yellow light conversion and leading to light with a lower CCT. In the transparent state the coating transmits most LED-emitted light resulting in light with a higher CCT. This leads to a CCT-controllable LED.

We show that it is possible to change the CCT of different types of LEDs by increasing the current applied to the LEDs when the PDLC coating is applied. In all cases the change in CCT was quantified and the change in CCT was found to depend on the type of LED used. For LEDs with a blueish color (7000 K), a change in CCT of over 10 000 K was measured. For LEDs with a more yellow color (3500 K), the measured change in CCT was smaller but still significant.

This research presented here was carried out as part of the EU project FP7-ICT-2011-7 (Intelligent and Luminous Textiles).

References:

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