Nanocomposite materials for shaping the diffusive transport of light

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Abstract

In the photonics community, disordered materials are being explored more and more due to their particular way to interact with light [1]. Typically, they are composed of non-absorbing building blocks with sub-micrometric size, distributed in a random way. As so, their refractive index is a complex function of position and light undergoes multiple scattering [2] thus, the transport is diffusive. If the scattering efficiency is equal for the whole visible electromagnetic spectrum, they present a white, milky aspect.
Not only they are very rich systems which exhibit challenging phenomena for physical interpretation, but also several research areas with social impact and industrial potential have emerged, ranging from random lasers to imaging through opaque media, for example.
Nanocomposites, formed by an optically functional phase embedded in a processable matrix, are a very versatile platform for developing optical applications [3] and, in this way, may be used for producing diffusive systems.
We would like to present our latest achievements in the field, which have been aimed at engineering the transport of light (specifically the transport mean free path) in nanocomposites based on multifunctional polymers presenting shape memory effect [4]. Different parameters such as the concentration of scatters or the temperature could be acted on in order to design materials which are almost transparent or, on the contrary, highly opaque.
We believe that our results might pave the way for more systematic investigations with potential impact on intelligent light sources with improved energy efficiency or new kinds of actuators.

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