Origin of structural colours in disordered scattering media

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Abstract

Structural colours arise from the interaction of light with materials that are structured on the
micro- or nano scale. Due to their broad range of tuneable parameters, amorphous assemblies of mono-disperse spherical particles are among the most promising systems that are easy to fabricate.
The propagation of light in such structures is characterised by multiple scattering, where short-range order and interference effects are highly important. The two main parameters describing the propagation are the transport mean free path lt and the absorption length labs. These quantities govern the interplay between scattering and absorption, thus shaping the reflection and transmission spectra.
In order to study this interplay, we prepare dense packings of mono-disperse silica particles of different sizes, mixed with varying amount of a broadband absorber (carbon black). We experimentally determine lt and labs by characterising the form of the coherent backscattering cone. We then compare these quantities to the measured reflection spectra, which allows us to links the structure's physical properties to colour quality.
This approach can provides a framework to effectively develop materials with enhanced structural colours by optimising parameters such as particle size, refractive index profile and packing order.

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