Structural colours via metal free disordered nanostructures with nm resolution and full CYMK colour spectrum

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Engineering colors through optical properties of nanostructures represents a research area of great interest, due to the many applications that can be enabled by this technology, from adaptive camouflage to micro-images for security and biomimetic materials [1-4].

In this work we develop a novel technique based on random structure patterning by means of electron beam lithography, able to generate all the fundamental colours with a simple, scalable, low cost and metal-free procedure. Engineering the scattering from complex media already demonstrated to be a successful in creating ultra-black material and new type of sources for optical applications [5].

Our new approach realises the fundamental colors of the CMYK (Ciano, Magenta, Yellow and Black) system, and therefore is able to represent any color in the spectrum, including variations in intensity.

Fig. 1 (a) Different filling fraction and doses for random patterns realised with circles of 80 nm, (b) Different filling fraction and doses for random patterns realised with circles of 150 nm, (c) Obtained colors mapped on a chromaticity diagram.

The absence of pigments in structural colours make them attractive for several reasons: they are environment friendly and they are robust and strong since they don't lose color under chemical or physical reactions.

Through a simple fabrication process involving electron beam lithography we managed to obtain all the fundamental chromaticities in CMYK system, as well as all the other colors present in the chromaticity diagram Fig. 1a, b and c.

This method is interesting in the field of micro-security, due to the impossibility of counterfeiting a random, three-dimensional pattern of pixels created on a transparent dielectric material.

Example References

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