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Structural "decoration" of plastic products replicated from nanoimprinted steel inserts

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Abstract

Structural colouration is a well-known "bio-inspired" phenomenon that explains the manufactured in a cleanroom by means of nanoimprinting lithography on steel astonishing natural iridescence of several animals' skin, such as: fish scales, birds' inserts. Gratings are subsequently replicated on plastic products by means of polymer feathers, butterflies' wings, flowers and more beauties in nature. The phenomenon injection moulding. This study focuses on understanding the technology readiness, occurs when light diffracts due to the topology of the just mentioned surfaces highlighting limitations and advantages of the adoption of structural colours in plastic independently from radiation-based colouring or pigmentation. In recent years, the consumer products. Aspects related to different polymer replication techniques of the rise of nanotechnology has brought about the possibility to design and reproduce nanostructures, metrological challenges to ensure manufacturing accuracy and structural colours on consumer products [1]. In this study, structural colours are precision of the mentioned features, the durability of the plastic gratings and the proposed as decorative features for plastic substrates. Periodic sub-micro gratings durability of the nanoimprinted injection moulding inserts would be key factors in showing a variable pitch (400 – 1500 nm) and step height (300 – 1000 nm) are understanding the applicability of structural decoration in the plastic industry.

Structural colours, Plastic decoration, Nano texturing, Nano Imprint Lithography, Injection Molding, Nano Tolerances, Multiscale metrology

Process chain enabling the production of structural Challenges and Technology readiness "decorated" plastic goods Manufacturing Metrology Accuracy of silicon **Replication fidelity** Technologies Tolerancing at nanoscale Flexibility of the Nanostructuring of a DTU Polymer stamps silicon master Multiscale quality control Steel inserts durability Contaminations and Plastic parts environment mouldability Nanoimprint Fabrication cost / mm² Technology awareness Lithography (NIL) of a polymer stamp Mass production **Decoration subjectiveness**



Fig. 1: Process chain for the production of structural decorated plastic components

Multiscale complexity and accuracy



Time-to-Market Design mix Economical

Customization

Application fields



Market

Replication fidelity



Fig. 3: Replication fidelity [4-5] from master geometry (left) and plastic part (right)

Conclusion

Structural "decoration" of plastic components through nano texturing is a successful example of how nano technology is brought to consumer products. Most of the economical and technological enabler for this to come true have been summarized in this poster. The specification of nanoscale tolerances for the replication fidelity of the grating structures are paramount in the effective replication of the decoration effect on the plastic component. The combined accuracy of silicon technologies replicated on mass production with injection moulding ensure a cost effective solution for tackle potential markets.



Fig. 4: Multiscale investigation from product decoration effect to nano grating

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