Color Effects on Nano Structured Surfaces

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For years plastic has been used for all kinds of applications due to its versatile properties. As focus on sustainability has increased, the ability to melt and recycle plastic materials has become increasingly important. This is already largely done in the production of e.g. plastic bags where the quality is perhaps compromise, but a cleaner product will enhance the possibility of using recycled plastic in a variety of products.

The general aim of this project is to develop a more sustainable alternative to one of the most widely used additives in plastic; *coloring by pigmentation*. The idea is that color decorations as we know them are to be replaced by the visual effects of periodic nano structures on the plastic surface. In particular, we envision making nano imprint an integrated part of the injection molding process and thereby eliminating both the additive itself and also reducing the sequences of production steps that might also cause additional transportation and thus further benefit the environment.

This study deals with the color effects of periodically spaced cylindrical PMMA structures. It has previously been found that aluminum coating is necessary in order to obtain clearly visible color effects, as these arise due to localized surface plasmons on the resulting aluminum disks. In principle, this jeopardizes the vision of a single material. However, the tiny proportion of aluminum (layer of 20 nm) in the product will not impact the reusability before numerous cycles (100 cycles from rough estimates).

Samples with periods of 160 to 240 nm and E-beam exposure doses of 30 to 180 $\mu C/cm^2$ were characterized optically and the reflected spectrum was found to depend strongly on the diameter as the resonance frequency of the localized surface plasmons is highly dependent on the height-to-width ratio of the Al disks.
The viewing angle dependency of the color, on the other hand, is related to the period, as small periods result in more constant color effects, as disturbances due to diffraction are found outside the visible range.