

Hybrid Micro and Nanostructures

Nanotech Security Corp



Nanotech has developed an innovative process of using hybrid micro and nanostructures to create optically variable banknote security features.

The platform consists of three categories of optical structure – micro-structures, sub-wavelength plasmonic nanostructures, and a hybrid of the two.

The company has invested around C\$20 million and a decade to develop the KolourOptik® technology platform, the products of which are customisable in terms of motion, 3D-depth and colour. The micro and nano-scale banknote structures are 10-20x thinner than lens-based optics, and are compatible with magnetics, overprint, and multiple application mediums such as stripes, threads and labels.

The innovation is based on tailored plasmonic nano-structure arrays, each exhibiting an independently unique

structural colour, adjacently placed along the contours of a microstructure to form striking effects. Combining micro-structures and nano-structures in this way creates a completely new optical platform for banknote security features with multi-colour imagery, full parallax depth effects and moving animations that work in any lighting condition.

This process overcomes the limitations of superimposing multiple advanced features which increase thickness and/or increase the number of materials required, leading to greater manufacturing difficulty, lower yields, and ultimately higher cost of the note.

It does so by imposing novel combinatory features beyond typical single-function designs. The nano-scale structures result in a pattern resolution of 254,000 dpi (100nm 'dots') or higher, while yielding potential perceivable image resolutions as high as 25,400 ppi (pixel per micron), and a thickness of less than 5 microns.

These hybrid nano-scale structures are more efficient than traditional grating and lens-based optics, as low aspect ratios lead to mechanically robust structures in thinner material layers.

They are also environmentally sustainable. No inks or harmful chemicals are required for production, all colours appear organically because of natural light manipulation by the hybrid nano-structure combination. And the use of a single origination and thus a single embossed/cast film minimises the environmental impact.

Due to the complexity of the hybrid structures, expensive and highly advanced technologies in Class-100 cleanrooms and accessibility to such equipment are required for development, with the features requiring multi-stage electron beam lithography originations and specialty manufacturing processes. This complexity deters counterfeiting attempts, particularly as the equipment needed is not open for consumer applications.

In summary, the pure plasmonic colour pixels patterned on ultra-thin microstructures create the thinnest, full colour 3D movement security stripes and threads and these are impossible to emulate with lenticular or holographic technologies.