

BANKNOTE TECHNOLOGY REPORT

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SECURE PRODUCTION FACILITY





NANOTECH SECURITY

NANOTECH DELIVERS
KOLOUROPTIK
TECHNOLOGY
– STUNNING
MULTICOLOURED
COMBINATIONS OF
DEPTH AND MOVEMENT



Nanotech Delivers KolourOptik Technology – Stunning Multicoloured Combinations of Depth and Movement

NANOTECH SECURITY

Nanotech Security Corp. (“Nanotech”) has a proven and respected history as a leading supplier of optical security solutions to the currency protection industry. Nanotech continues its leading-edge innovation by delivering visually stunning, technologically advanced, and nearly impossible to replicate optically-variable security devices (OVD).



CLICK OR SCAN



This year, Nanotech introduces the latest advancements in its proprietary KolourOptik® technology; security features with multi-coloured 3D stereo depth effects now combined with striking movement effects. Together, these effects deliver a compelling and engaging authentication experience far superior to legacy technologies available in the banknote market.

With decades of experience manufacturing and supplying LumaChrome colour-shifting optical thin films, Nanotech has a trusted network of partners and customers throughout the banknote industry. In recent years, Nanotech has established itself as a vanguard in innovative nanooptic solutions with its proprietary KolourOptik technology. In 2020, Nanotech introduced KolourDepth™, a new product exclusively available to the government high security and banknote industry. Following this introduction, Nanotech's KolourOptik platform was recognized by the International Association of Currency Affairs as a finalist in the 2020 Excellence in Currency Technical Awards, in the category of 'Best New Currency Innovation'.

EVOLUTION AND INNOVATION OF KOLOUROPTIK TECHNOLOGY

Exclusive to the banknote and government high-security market, KolourOptik technology uniquely showcases the combination of multiple significant optical security effects, such as multi-colour, 3D depth, and motion. While each characteristic individually serves as a strong banknote security measure, when combined, these effects exhibit extraordinary synergy, such that the whole security feature solution is much greater than the sum of the individual effects.

'Always-on' optical security features are active and visible across a wide viewing angle. This is especially important in banknote security to ensure reliable authentication and security performance in both lowlight conditions and environments with multiple, diffused light sources. Leveraging decades of experience with optical thin film, Nanotech recognized the importance of multiple colours within a single optically variable effect, as it relates to human visual perception, and has included multi-colour designs as one of the core features of KolourOptik technology.

Similarly, perceived depth is an important authentication tool for security features as it supports intuitive authentication within a brief viewing period, performs well under low illumination, and is readily visible when a banknote is static.

Studies have shown that the cognitive processes involved in the visual authentication of banknotes are multistage processes, operating in the order of hundreds of milliseconds. It has been demonstrated that an exposure to a security feature with

3D depth for a mere 100 milliseconds is adequate for the human brain to create signals and confirm authenticity, while exposure of half a second increases the rate of correct authentication significantly. (J Raymond et al, '3D Micro-Optics Enable Fast Banknote Authentication by Non-Expert Users', Optical Document Security Conference 2020, S5P2, San Francisco USA). Adding movement to a feature further enhances the security and recognition of the OVD.

This year, Nanotech has further developed its KolourOptik platform to incorporate striking movement effects into security features, providing both an opportunity and the encouragement of customer interaction and engagement to deliver a compelling authentication experience. By combining movement and depth, Nanotech has created unique designs with images that appear at various depths within 3D space and slide above or below each other. The ability to selectively obscure and reveal optical images beneath one another on a 2D banknote surface delivers an instinctively compelling reaction. Employing multiple colours, shapes and geometries, Nanotech is able to offer uniquely intricate designs that can be customtailored to any national design or denomination theme.

Nanotech's new KolourOptik technology offers central banks, issuing authorities, and commercial print works the unique ability to honour their traditional banknote design guidelines, enhance their storytelling experience, and provide the strongest optical security that will continue to serve as a robust and effective anti-counterfeit measure for years to come.

STAGE 1

0.5
SECONDS

Customers/ merchants adjust hand posture swiftly to view the banknote

STAGE 2

No Suspicion

■ Suspicion Raised



The brain asks if this is a regular banknote or not by making a fast sensory analysis in terms of paper, colour, line, depth, motion

200
MILLISECONDS

Fast check for critical visual cues is performed

700
MILLISECONDS

Further evaluative analysis, scrutiny follows as a slow inspection



CLICK OR SCAN

BIOMIMICRY: INNOVATION INSPIRED BY NATURE

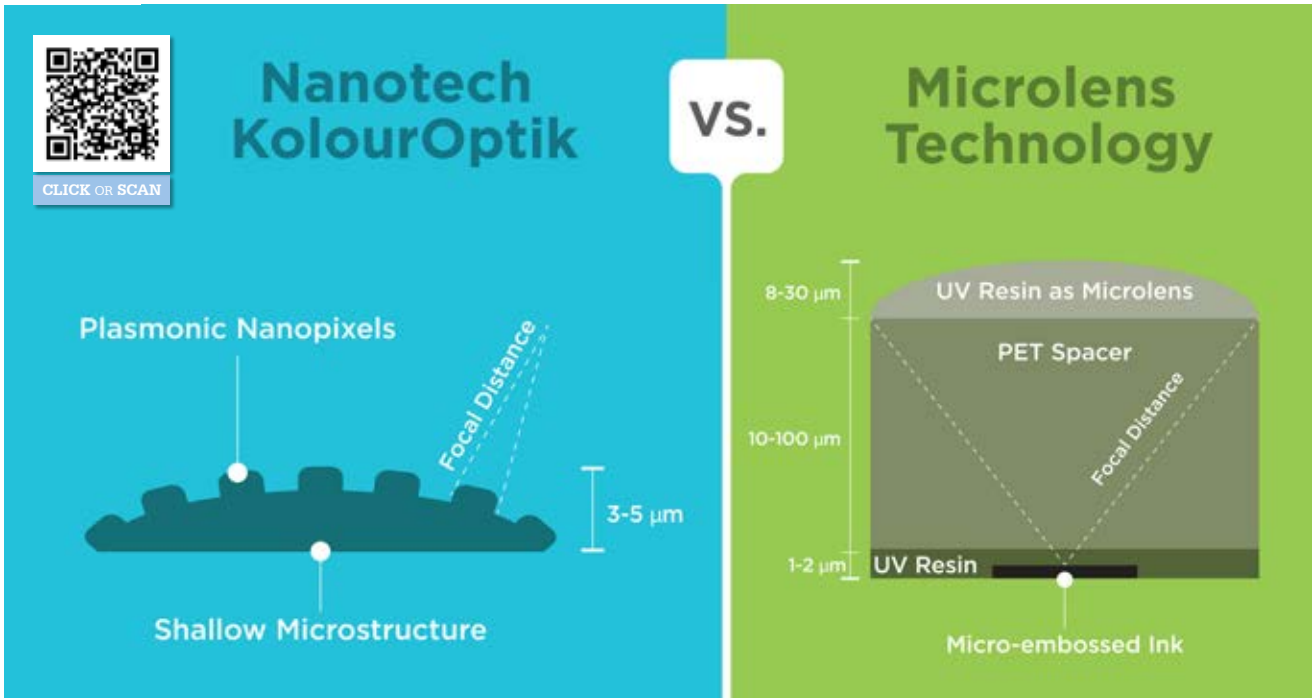
It is often said that necessity is the 'mother of all invention' but a strong argument can be made that Mother Nature is the greatest innovator. Nanotech's KolourOptik technology is biomimetic innovation at its best. Inspiration for KolourOptik technology is drawn from the Blue Morpho butterfly of Central America, whose iridescent colours are produced by nanostructures that absorb and reflect specific wavelengths of light. Nanotech Security has harnessed the surface plasmonic resonance effects of nanotechnology to create similar dazzling colours, movement, and depth effects without the use of lenses or printed inks. Through the complex and proprietary combination of metal and dielectric materials constructed with subwavelength nanostructures, Nanotech delivers optical security innovation for the banknote industry.

KolourOptik nanostructures are used to change the colour of a metal surface through selective light wave absorption, reflection, and transmission. With more precise control of the hue and saturation, the resulting effect is closer in look to metallic colour pigments than more traditional diffractive "holographic" effects.

Nanotech's new KolourOptik technology motion effects are a result of a unique combination of expertise in motion and graphic design, electron beam lithography, and proprietary optics modelling and software development. Working at nanometer scale, Nanotech can create ultra high-resolution imagery that is unmatched by any lens-based or print technologies.

The combination of microstructures with sub-wavelength nanostructures allows Nanotech to deliver unprecedented control over the reflection of light at the macro and micro level.





SIMPLE IS HARD: UNIQUELY SECURE AND TECHNOLOGICAL BENEFITS

KolourOptik technology incorporates multiple effects into a single feature which represents significant challenges to counterfeiters. Unique, single construction technology delivers the thinnest and most robust solution on the market, making it ideal for a variety of formats and applications, from paper to polymer.

Plasmonic nano-optic technology can create unique combinations of colour, depth, and movement through the complex arrangement of subwavelength structures, without increasing the thickness of a feature. Proprietary software and EBL design processes strictly control the OVD movement, perceived depth, and colour palette through a unique arrangement of nanostructures. In fact, security features with KolourOptik technology are one of the thinnest depth or motion optical security features on the market today. With heights of only 3 – 5μm they are an

order of magnitude less than the typical 20 – 130μm thickness required by microlens structures.

While KolourOptik structures and processes are complex, the materials are simple and drastically reduce the production variables while increasing durability, consistency, and application compatibility. Without the use of printed inks or micro-lenses, currency suppliers can avoid the associated cost, thickness, and application test variables.

Beyond its thin construction, movement effects in a security feature serves as the foundation for another critical benefit; intuitive customer engagement. Just as the eye is naturally drawn to movement, so too are end-users and their desire for interaction. With features that have KolourOptik technology, users can tilt the banknote to align visually appealing patterns or assemble the geometric components of their national flag. The unexpectedness of moving images on a two-dimensional banknote delivers

an awe-inspiring and memorable experience that encourages banknote self-authentication, without additional tools or processes. Security features with movement effects are easy to explain and recognize, while nearly impossible to duplicate with competing optical security technologies.

The principal advantages of Nanotech's proprietary KolourOptik technology include:

- (1) application in a wide variety of formats, such as stripes, threads, patches, etc.,
- (2) high visibility,
- (3) easy to trigger,
- (4) high interactivity, and
- (5) high degree of freedom for design and customization.

CONCLUSION

Nanotech developed KolourOptik technology to deliver the two most important measures of an optical security feature's effectiveness; how well it aids in authentication and how well it deters counterfeiters. Through cutting-edge, proprietary technical processes Nanotech has produced optically-variable features that are intuitively engaging and add new

dimensions of movement and depth to banknote security, far above the capability of counterfeiters. Adding movement and 3D depth to security features creates a naturally memorable authentication experience that is simple to explain, easy to recall, and intuitive to use. Nanotech is excited to bring KolourOptik technology from research and development into commercial production and is working with trusted industry partners to deliver the next generation of banknote optical security features.

NANOTECH SECURITY.

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Advantages of KolourOptik Technology

