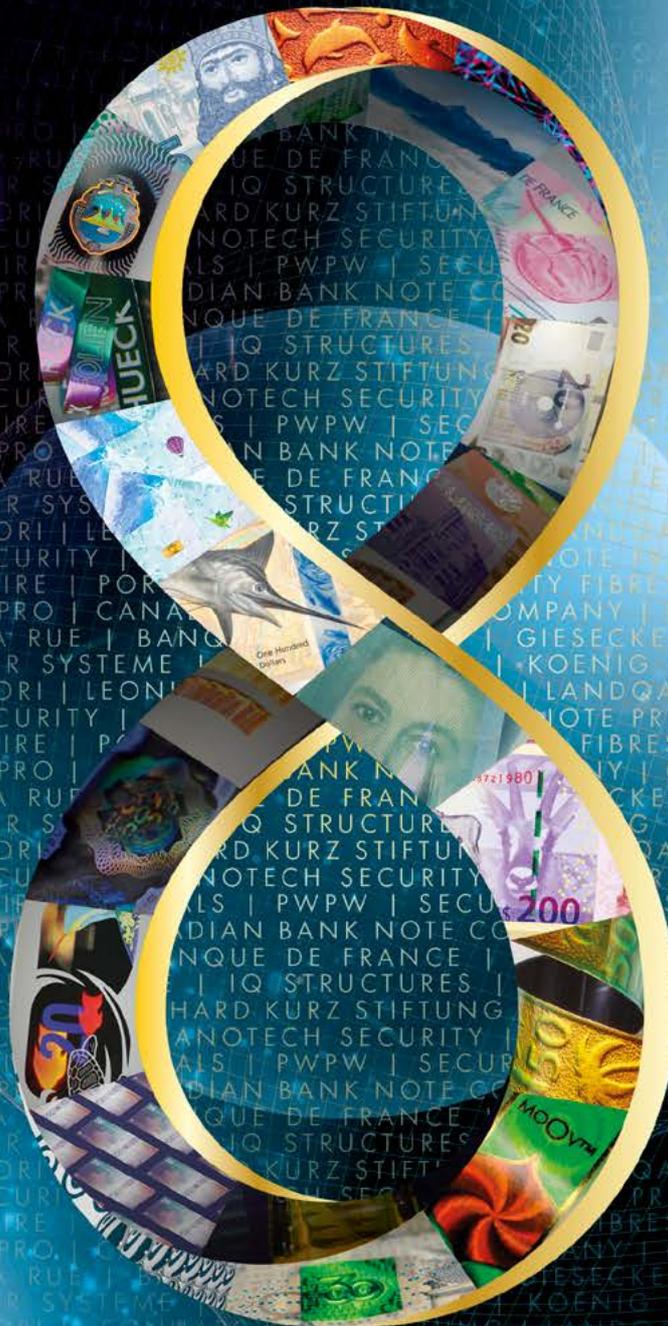


# BANKNOTE TECHNOLOGY REPORT

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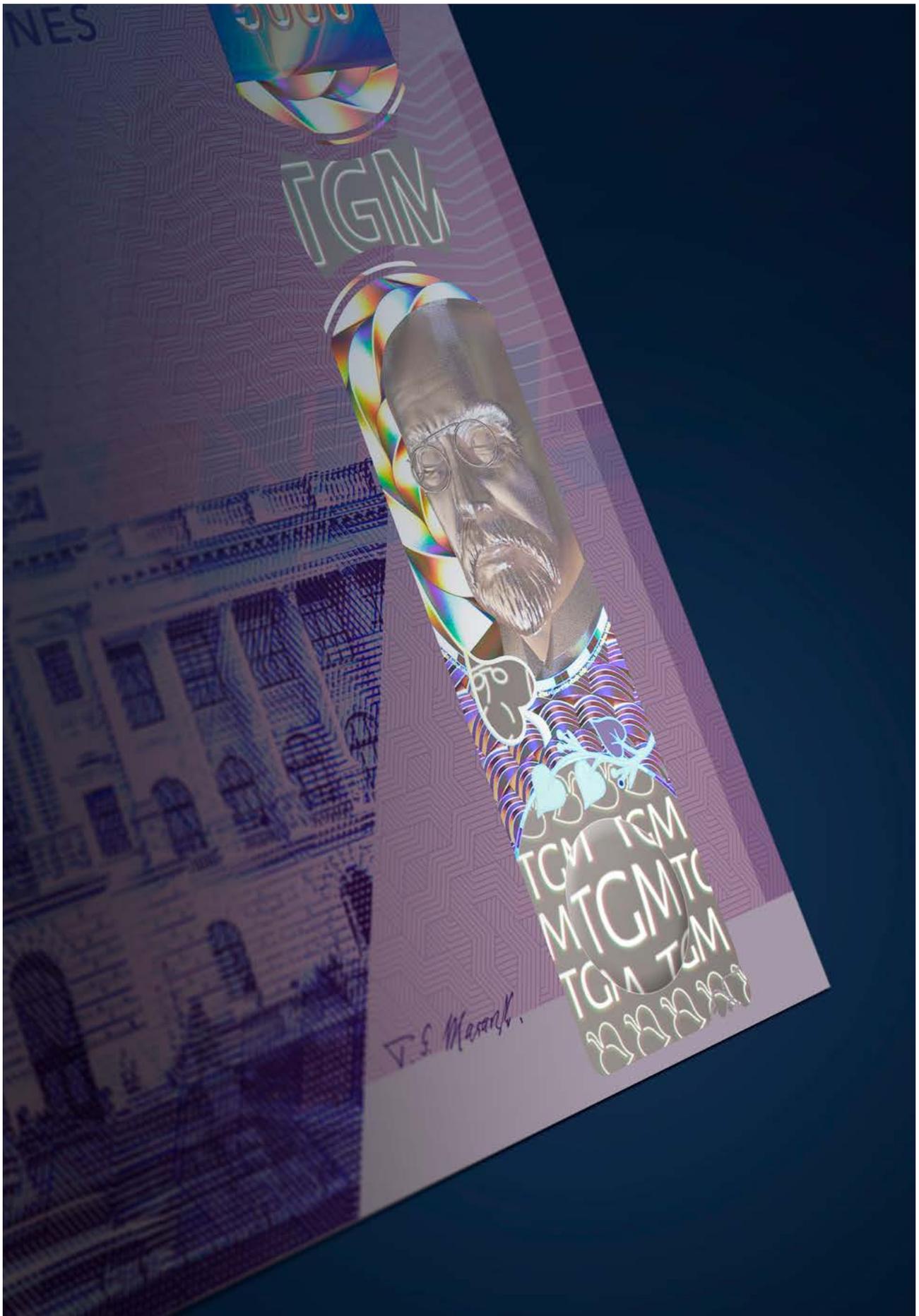
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**IQ STRUCTURES**

**NANOENGINEERED  
COLOURLESS OPTICAL  
SECURITY FEATURES FOR  
MODERN BANKNOTES**





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# Nanoengineered colourless optical security features for modern banknotes

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## IQ STRUCTURES

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A company within the IQS Group, is focused on the development and manufacturing of novel optical security features for protection of banknotes, identity documents and other valuables. It uses the extensive know-how and expertise of nano-and micro-structuring of surface as well as volume elements using electron beam and laser lithography, 3D nanoprinting and nanoimprint lithography. IQS Group's nanoengineered elements, objects and structures, are used in various industries such as pharmaceutical, bio-engineering, automotive, lighting and others.



**T**omas Garrigue Masaryk (T.G.M.), the man of bright intellect, firm moral attitudes and unpretentious humanity. The first president of the Czech Republic. Following the dream of free, self-confident and cooperative individuals, he created an environment for the birth of creative society. The Czech Republic was born, a country with a refined sense for innovation. The country where nylons, contact lenses and HIV antiviral drugs were developed. The country where the use of electron beam lithography for diffractive optics has been pioneered.

The recently developed colourless optically variable features are based on the advanced e-beam lithography, and focuses on a strong and unambiguous visual experience. All so called "Achromic" effects are created using the computer-generated optical modules, defining the diffractive functionality of each nanoscale element forming the final visual appearance of the feature. Despite the overt visual performance, the nanoengineered nature of the features allows the integration of covert as well as forensic elements - the must have components of all optical security features for protection of banknotes.

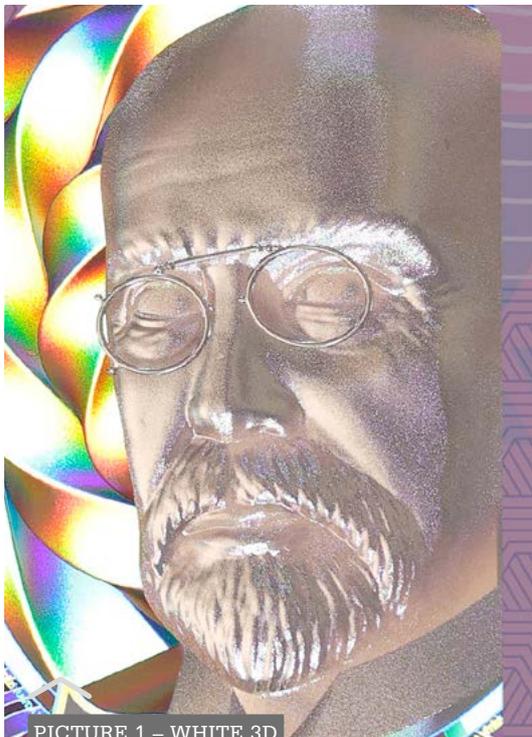
All Achromic effects are suitable for holographic stripes and patches used on paper, hybrid and polymer substrates, as well as holographic window threads integrated in the paper substrates. Based on diffraction optics topology the features may be easily implemented in any foil construction.

### WHITE 3D

The effect appears as a non-chromatic bas-relief with high-resolution details. It doesn't change its appearance when tilted and/or rotated. The bas-relief seems to have a height of approx. 1 mm, but the real depth of the relief forming this effect is around 800 nm. It's the depth which human touch sensors cannot indicate. Due to this fact the feature

„The serious protection is both art as well as science.“

**Petr Franc, CEO**



PICTURE 1 – WHITE 3D

can be authenticated by non-tactile response when touching it. Using the 3D scanning approach or modelling for creation of the effect, any person or object can be reproduced. See picture 1 for the detail.

„Banknotes have always been a fascinating medium. The medium where past and heritage meet the innovations. The technology pioneer telling the old stories of people and nations by the means of latest developments. A contradiction which has been creating an explosive mixture of creativity and knowledge attracting artists as well as scientists and engineers. Hence the theme for an introduction of our novel nanoengineered optical security features for banknotes protection is an inherent part of our past. The first Czech president Tomas Garrigue Masaryk, a man who encoded the ethos of knowledge and humanity in the Czech society.“

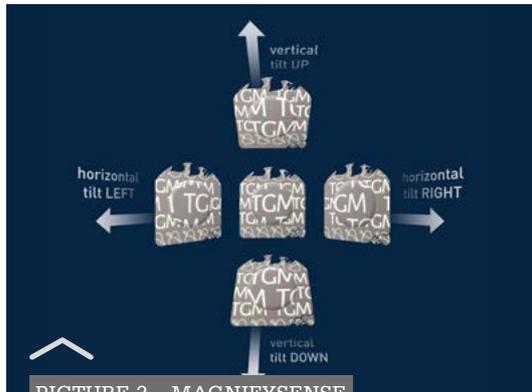
**Robert Dvořák, Managing Director**

### MAGNIFYSENSE

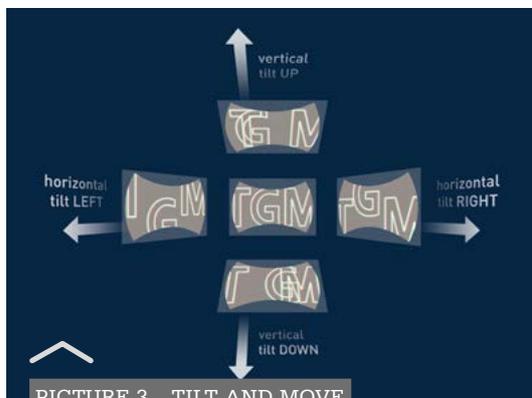
The effect consists of non-chromatic elements (letters, numbers, geometrical objects) hovering below the plane of the feature. When tilting the feature, particular non-chromatic elements are being magnified. The magnification can vary depending on the complexity of the elements. See picture 2 for the explanation.

„Our approach is to create strong visual experience for the user. To catch his eyes using the means of classical diffraction and develop the interaction with the features through their interactive and colourless manner. Our dream is to develop features which are considered by the users to be the games. The games which are played each time there's a payment action.“

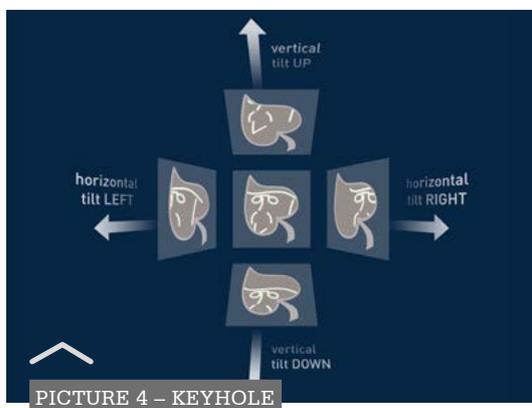
**Jan Dřevíkovský, Senior Designer**



PICTURE 2 – MAGNIFYSENSE



PICTURE 3 – TILT AND MOVE



PICTURE 4 – KEYHOLE

## TILT AND MOVE

The effect is formed by non-chromatic elements (symbols, letters, numbers, geometrical objects) hovering below the plane of the feature. When tilting, the elements move in a counter-intuitive manner. When tilted up and down the elements move left

and right and vice versa. See picture 3 for the example. The moves of particular elements can be realized in different depths below the plane of the feature. A morphing, shape changing effect can be integrated.

„The goal of our innovation was to create strong overt effects which will be easily authenticated by the general public. Three major criteria of such effects were defined. The interactivity, the effect must provoke the user for an action, for an active interaction. The simplicity, the feature has to be recognized at the first sight. The visual unambiguity, the effect must be authenticated within few seconds. Following all three above mentioned aspects we have created features which can be described by a phrase „monochromatic action“. They are colourless and interactive.“

**Petr Červenka, Head of mastering**

## KEYHOLE

The effect is created by a non-chromatic element (symbol, geometrical object, letter, number) hidden in or below a display area within the feature. The element is larger than the display area, thus only part of the image is visible. To reveal the whole image the feature must be tilted left/right and up/down. See picture 4 for the example. Due to its nature the effect may be used among the others as an optically variable feature for narrow window threads.

## IQ STRUCTURES

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