

# BANKNOTE TECHNOLOGY REPORT

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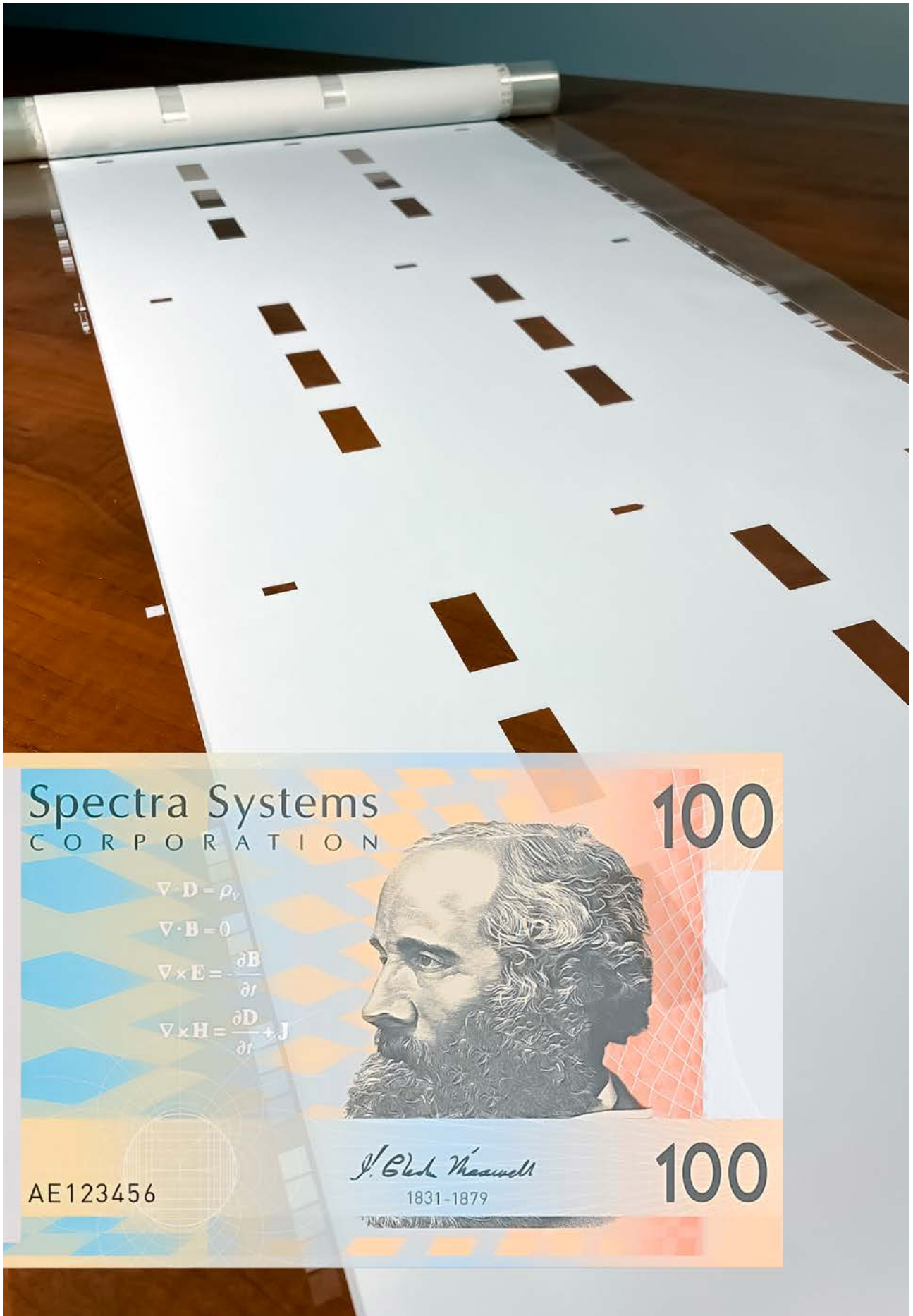
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## Additional: CURRENCY RESEARCH

[www.banknote-industry-news.com](http://www.banknote-industry-news.com)

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**SPECTRA SYSTEMS  
CORPORATION**

**MACHINE READABLE  
POLYMER BANKNOTE  
SUBSTRATES AND  
ADVANCED OPTICAL  
MATERIALS**



# Machine Readable Polymer Banknote Substrates and Advanced Optical Materials

## SPECTRA SYSTEMS

In collaboration with a global supplier of biaxially oriented polypropylene (BOPP), Spectra Systems has developed a new covert (level III) polymer substrate for high-reliability, high-speed machine-readable banknote security. The covert taggants and detection system enable central banks to have their own unique codes when paired with a sensor system that detects and verifies the specific signatures.



Substrate embedded security features have afforded central banks the highest level of security and the ability to verify authenticity at the fastest sorting machine speeds. This has been the case for paper-based banknotes for many years, however, embedding taggants in polymer has been a particularly difficult problem when low haze values ( $<2.5$ ) are required for the transparent window, the signature public security feature of polymer banknotes.

Spectra, working with a leading global and research driven supplier of BOPP, has produced substrate which meets all of the industry standards while being machine-readable at the highest speeds and with false accept and false reject rates comparable to the lowest values obtained in paper-borne features. The substrates are compatible with all of the other applied security features in the form of inks and foils and exhibit superior mechanical strength, shrinkage, stiffness, thickness control, haze and print properties. As the substrates are corona and flame treated, they have exhibited excellent printing properties both with opacity and anti-static coatings, as well as subsequent banknote design printing. These newly available substrates have multiple signatures allowing for covert level III machine-readable authentication which is specific to a given central bank. Current capacity for these substrates is 2 billion notes annually and will increase to 10 billion by the end of 2020.

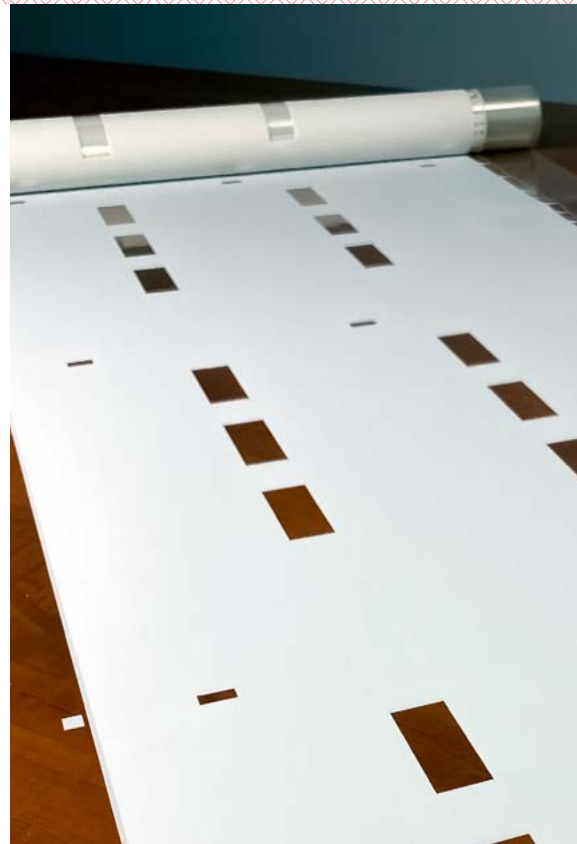


## CRITICAL PROPERTIES OF MACHINE READABLE POLYMER SUBSTRATE (MRPS)

The table below compares the physical properties of typical polymer banknote substrates with that of Spectra's new Machine Readable Polymer substrate (MRPS). The MRPS material values point to its suitability for use in polymer banknotes. Additional critical performance metrics include printability/adhesion, and support of foils. Corona/flame treatment during manufacturing is effective in preparing the surface for excellent adhesion of the white opacity layer and application of foils.

## AUTHENTICATION SPEED AND READ RATE PERFORMANCE

The authentication sensors, designed in parallel with the development of the MRPS



	Method	Typical Industry Values	MRP
Heat Shrinkage	MD	3.15	2
	TD	1.57	0.5
Mechanical (Modulus psi)	MD	274000	370000
	TD	376000	630000
Mechanical (Strength psi)	MD	18000	21500
	TD	34000	46000
Mechanical Strain (Strain %)	MD	220	220
	TD	50	45
Haze	1 sheet	2.3	2.3
Stiffness (1 sheet, mN)	MD	52	66
	TD	115	140

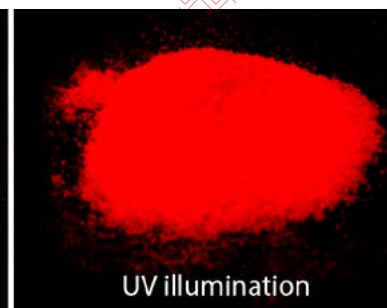
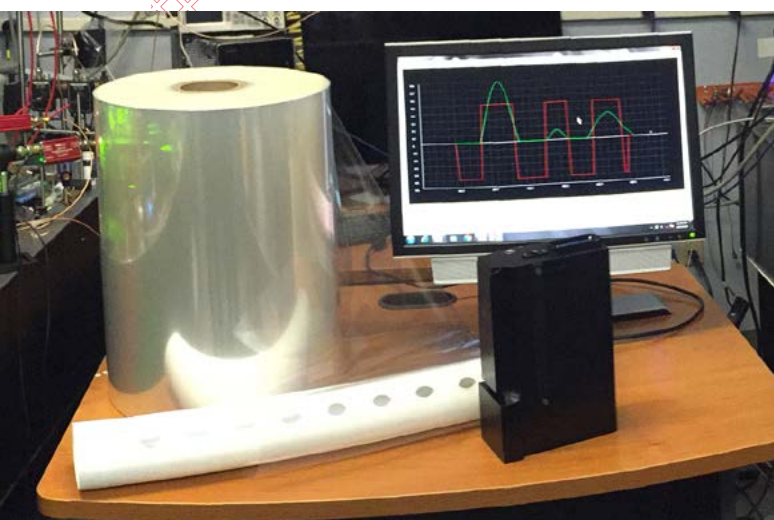
MD - Machine Direction

MRP - Machine Readable Polymer

TD - Transverse Direction

substrate, have the ability to detect the feature at speeds of 15m/second, which exceeds the transport speeds of the fastest sorting machines currently used by central banks. Under testing, read rates have been found to have a false reject rate of as low as 1 in 100,000. Owing to the intrinsically robust family of tagagnts, read rate performance will be stable across the life time of the banknote.

Currently available Red phosphors tend to be expensive and limited in brightness and lightfastness properties. A breakthrough



## ADVANCEMENTS IN LUMINESCENT MATERIALS FOR INK BASED SECURITY

In addition to the covert security of our MRPS, new developments in overt optical materials offer ink based features that can be used in the printing of MRPS banknotes, as well as paper based notes. These include a set of proprietary "gasochromic" phosphors and a newly developed fluorescent Red phosphor. The gasochromic material emits under UV illumination only when a weak stream of nontoxic gas is applied to the area of the banknote containing the material.

Red emitting phosphor for this specific application has resulted in a colourless, very bright, lightfast ( $L > 5$ ), red phosphor particularly suitable for UV LED excitation.

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