

**Because sometimes perspective DOES matter!**



**Realtime magneto-optical field viewing**

## Magneto-optics - Products

### Wafers and Systems:

#### 04 .... **Magneto-optical wafer and theory:**

Theory of magneto-optical visualization and presentation of magneto-optical wafers. Information about wafer's geometry, size and different types of sensitivity.

#### 06 .... **CMOS-MagView:**

State of the art magneto-optical system for visualization, measurement and analysis of magnetic field distribution and homogeneity by use of the powerful CMOS-MagView user software.

#### 08 .... **Handheld MagView:**

Handheld device for visualization and optical analysis of magnetic field distribution and intensities. Specialized for mobile usage and on-site quality control.

#### 09 .... **MOSES II:**

Specialized magneto-optical system for visualization and analysis of magnetic data, audio and video tapes including evaluation software.

#### 10 .... **MObjektive:**

Magneto-optical zoom objective adapter for petrographic microscopes. Designed for detailed material investigations and hard drive, floppy disk visualization. Due to maximum resolutions up to 1  $\mu\text{m}$ , the MObjektive is perfectly suited for scientific research and quality control of magnetic domains - static as well as dynamic.

## Magneto-optics - Applications

### General fields of Applications:

#### 12 .... **Permanent Magnets:**

Quality control, regarding homogeneity, cracks and measurement of magnetic field structures and distribution of permanent magnets (dipole and multi-pole).

#### 14 .... **Linear & rotary Encoders:**

Quality control of magnetic linear and rotatory encoder structures regarding geometrical and corresponding flux density measurements.

#### 16 .... **Magnetic stripe cards:**

Quality control of magnetically stored information of magnetic stripe cards (swipe cards) regarding magnetic field and geometrical analysis. In addition also fraud protective investigations can be performed in order to detect manipulated information.

#### 17 .... **Magnetic ink:**

Quality control of magnetic ink's properties for MICR-compatible prints as well as fraud protection and verification of security inks for hidden safety signs.

#### 18 .... **Banknotes:**

Forensical investigations of banknotes regarding specific magnetic security signs in order to identify frauded or forged banknotes.

#### 19 .... **Floppy & hard drive disks:**

Investigation of magnetic data carriers in order to identify defects and to reconstruct information on damaged carriers (for example airplane flight recorder tapes).

#### 20 .... **Magnetic tapes:**

Investigation of magnetic data, audio and video tapes regarding traces of manipulation and reconstruction of damaged structures.

#### 21 .... **Vehicle Identification Number (VINs):**

Forensical investigations and reconstructions of obliterated (ground) serial numbers in metal (for example VINs and serial numbers on firearms) in order to trace the holder.

#### 22 .... **Welding seem:**

Inspection of welding quality and identification of hidden welding seems regarding fraud protection for identification and authentication plates and signs.

#### 23 .... **Domain research:**

Magnetic domain research (static and dynamic) and magnetic mineralogy investigation and research.



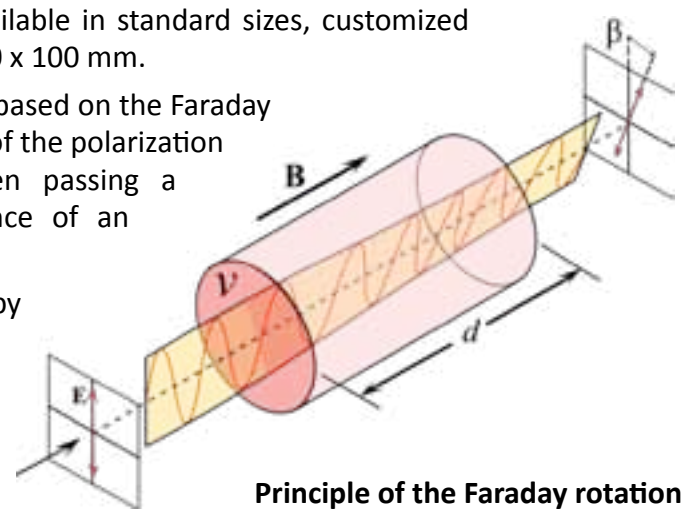
## Magneto-optical wafers

The magneto-optical technology is an imaging method for magnetic measurement, forensic investigation and non-destructive testing. The magneto-optical wafers provide field analysis and quality assurance of different magnetic materials. Magneto-optical wafers with different measuring ranges are available in standard sizes, customized geometries and as sensor array up to 100 x 100 mm.

The magneto-optical wafer's principle is based on the Faraday effect. This effect describes the rotation of the polarization plane of linearly polarized light when passing a magneto-optical thin film with influence of an external magnetic field.

The different plane rotations are caused by different refractive indices of the magneto-optical layer for left- and a right-circularly polarized wave parts of the polarized light. The rotation angle of the polarization plane is formally defined by the empirical equation  $\beta = V \cdot d \cdot B$ .

Using polarizing filters, different strengths of local magnetic fields cause light intensity changes due to different angles of the Faraday rotation. This magneto-optical image enables a direct real-time visualization of magnetic stray fields over the entire sensor surface up to 3 inch.



**Principle of the Faraday rotation**

$d$  = MO layer thickness  $B$  = Magnetic flux density

$V$  = Verdet constant  $\beta$  = Angle of rotation

Magneto-optical wafers are in use for quality control of magnetic materials as NdFeB, SmCo, AlNiCo and hard ferrite, fraud and forgery inspections of magnetic ink and forensic magnetic tape investigations. The wafers are used for quick and reliable high-resolution visualizations, analysis and characterization of magnetic materials or products.

All magneto-optical systems are based on magneto-optical wafers. The area of visualization therefore depends on the size of the installed wafer. Different types of wafers are capable of visualizing and measuring specific field intensities depending on the specific demand of the application.

### Following wafer types are available:

Type	Measuring range at RT (kA/m)	Base	Typical applications / materials
A	0.05 to 2.0	1 inch 3 inch	Magnetic stripe cards (LoCo), hard magnetic inks (banknotes), steel alloys (material testing), magnetic tapes (audio tape manipulation testing), minerals (thin sections)
B	0.05 to 30.0	1 inch 3 inch	Magnetic stripe cards (HiCo), polymer bounded permanent magnets (material testing), magnetic tapes (audio tape manipulation testing), domain material (magnetic shape memory)
C	0.05 to 160	1 inch	Magnetic encoders, dipol- and multipol permanent magnets and polymer bounded magnets and foils
D	0.03 to 5.0 (special for Bias)	1 inch	Printed magnetic inks (documents, banknotes testing) and magnetizable steels alloys (car serial numbers testing)

### Wafer geometries (in mm):

Thickness: 0.5  
Diameter: 25.4, 76.2  
Rectangle\*: 8 x 8, 17 x 8, 15 x 20, 45 x 60  
Array setup: customizable up to 100 x 100

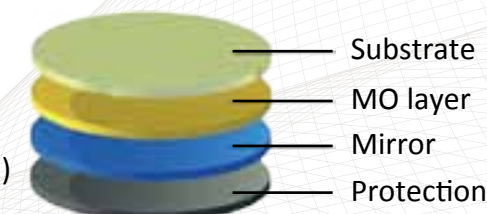
\*Special sensor geometries on request

### Wafer characteristics:

Temperature resistance: +10 to +50 °C  
Working temperature: +15 to +30 °C  
Optical transmission range:  $\lambda > 530$  nm  
Optical resolution: 1 to 25  $\mu$ m  
Faraday rotation ( $\lambda=590$ nm): 1 to 10°

### Additional functional layers on magneto-optical wafers:

- Mirror layer (visible spectral range) for high reflectivity
- Resistant material layer for mirror protection
- Anti reflexion coated glass stabilization (thickness + 1 mm)





## CMOS-MagView - visualization and measurement of magnetic fields

The CMOS-MagView is the digital magneto-optical readout system for fast and accurate visualization of magnetic field structures. It is compatible for all available sizes and types of magneto-optical wafers. Due to the compact and adjustable design the CMOS-MagView is easy to implement into existing production and quality control processes.

Included within the CMOS-MagView system package is a comprehensive analysis and protocol software for evaluation of magnetic field distribution, homogeneity and measurements of field intensities. For special tasks of automatisations and specified field tolerances the software is customizable to perfectly match the users needs.

Beside the CMOS-MagView with wafers of type A, B or C, the D type equipped CMOS-MagView is specially designed to work in BIAS-mode. For investigations of soft magnetic materials the BIAS-CMOS-MagView uses permanent magnets for generation of a homogeneous magnetic field parallel to the wafer's surface. Materials applied to the wafer will be magnetized by the external magnetic field to cause magnetic leakage fields, which are then detected by the magneto-optical chip. For applications as magnetic ink visualization, bank note investigation, recovery of obliterated serial numbers and quality control of welding seems the BIAS-CMOS-MagView is the first choice.

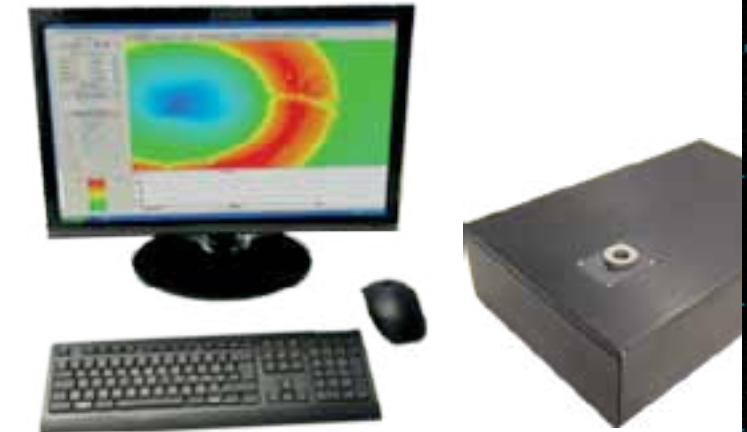
Additionally for several tasks it is also necessary to have an alternating magnetic field applied to the testing object. For applications of this kind, the CMOS-MagView is also extendable by an alternating field module in order to maximize the leakage fields and therefore to maximize the recognizable magnetic information of these visualizations. For dynamic magnetic domain investigations, the CMOS-MagView with type D wafer can be equipped with a special magnetization module to generate directed magnetic fields to analyse the domain behavior of magnetic domains for different field intensities (for example for electrical steel testing).

The CMOS-MagView visualizes magnetic flux densities and their changes in optical resolution. Inhomogeneities and cracks in ferromagnetic materials can be shown directly using sensitive magneto-optical wafers.

For a measurement the wafer is brought into direct contact to the surface containing the magnetic information. The CMOS-MagView software allows analysis of magnetization properties and the documentation of the specimen.

### Function

- Integrated homogeneous, linear polarized illumination (LED)
- Change of the polarization status of light within the magneto-optical wafer depending on the applied local magnetic field
- Analysis of local intensity changes via second polarizer
- Recording of the magneto-optical image via CMOS-digital camera

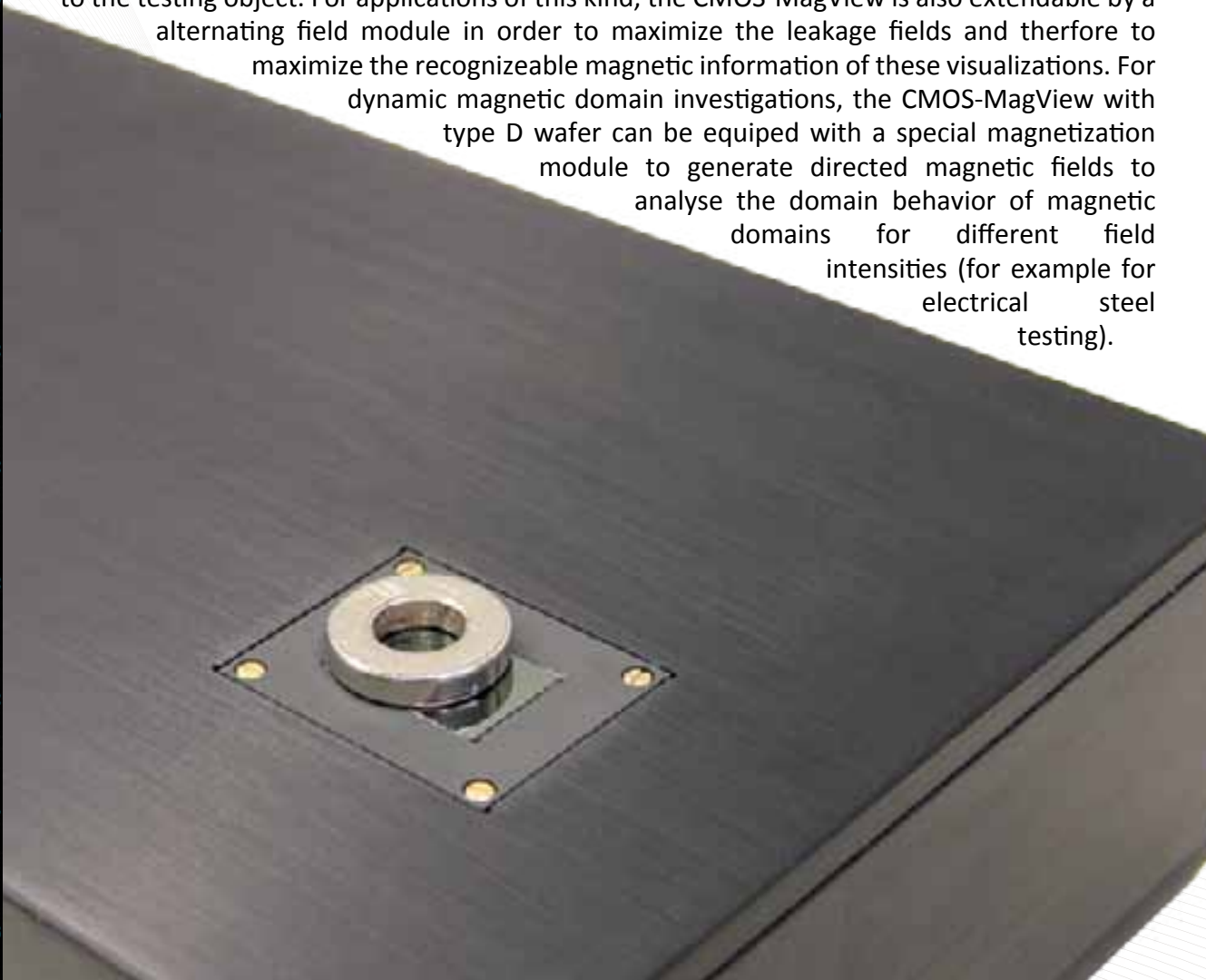


### Technical features

- Areal direct visualization and measurement of magnetic fields
- Investigation in visible spectral range
- Analysis of: polarity, homogeneity, distribution of the magnetic material and magnetization properties
- Field range: 0.01 to 160 kA/m (0.1 to 2,000 Oe)
- Wafer size: up to 45 x 60 mm
- Resolution: 25  $\mu\text{m}$

### Modules and specialized setups

- Standard CMOS-MagView (wafer types A, B and C)
- BIAS-CMOS-MagView (using permanent magnets to create parallel magnetic fields)
- Alternating field module (for generation of alternating magnetic fields)
- Magnetization module (to generate directed and defined magnetic fields)
- Video-Capture module (for visualization of dynamic magnetic field changes)





## MagView

The handheld MagView is the mobile magneto-optical readout device for on-site checks and in-production quality control. It is also compatible for all available sizes and types of magneto-optical wafers.

The MagView was designed as a cordless handheld device for fast investigations and mobile quality control.

As the CMOS-MagView, the MagView is also available as BIAS-MagView in order to generate leakage fields and therefore to investigate magnetic ink, bank notes, serial numbers and welding seams.



## MOSES II - Magneto-Optical Sensor System II

MOSES II is a magneto-optical readout system for forensic investigations. It enables a quick and reliable visualization of the magnetic tape information. Based on the modular design MOSES II supports the investigation of all types of commercially available tapes.

Magnetic fields can be found on all magnetic information carriers such as data-, audio- and video-tapes. This magnetic information unfortunately can be easily copied and manipulated. However, there always remain traces which can be visualized by magneto-optical systems. These traces for instance occur due to the mismatch or the tilting of the audio head. Other factors for traces are typical touchdown and lift off marks of the audio head which are pretty easy to identify.

MOSES II was specially designed to fulfill the needs of magnetic tape investigations. Using several tape adapters the MOSES II is capable of handling all available magnetic tapes. Additionally there is an audio-module available in order to have the possibility to check the magnetically stored information while hearing the sound of the audio tape simultaneously. Therefore suspicious noise patterns may be investigated specifically in order to identify and verify traces of manipulation.





## MObjective - Magneto-Optical objective adapter for petrographic microscopes

The MObjective is an objective adapter with integrated magneto-optical wafer for microscopic investigations, which is mounted directly on the objective lens of polarization microscopes.

The MObjective allows fast and high-resolution analysis of magnetic structures in the range of single micrometers. Magnetic fields of storage medias, magnetic steel alloys, domain materials, conductors and permanent magnets can be visualized with the MObjective.

The MObjective adapter is available for all petrographic microscope objectives and can be equipped with wafers up to 3mm x 3mm of all available magneto-optical wafer types.



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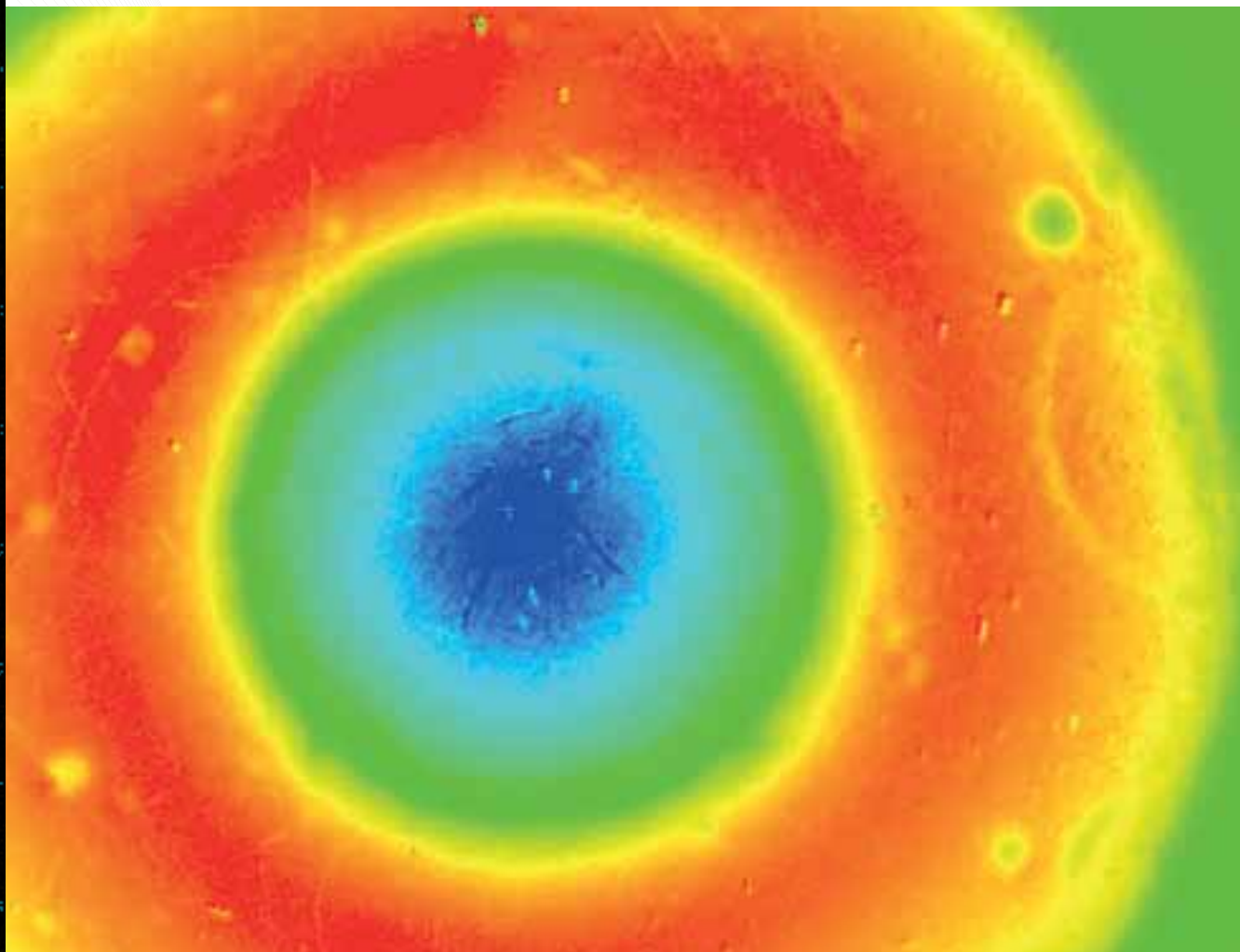
## Permanent magnet's quality control

Due to the manufacturing process of permanent magnets inhomogeneities in distribution of the magnetic material and therefore inhomogeneous magnetic fields can occur. These defects are very hard to identify with standard magnetic field measurement instruments as hall-probes or magnetoresistive sensors, due to the evaluation regarding homogeneity of magnetic fields distribution has to be performed over a large area. Standard measurement devices are working in scanning mode over the investigation area.

For quality control applications regarding magnetic field distribution, magneto-optical systems do offer a huge advance. They simultaneously image the magnetic field distribution and measure the corresponding magnetic field intensities for areas up to 3 inches in diameter in real time.

Therefore magnetic fields or material defects can be identified and protocolled at a glance. Magneto-optical systems create 2 dimensional cuts through the magnetic field at the surface of an object. Therefore it is also possible, not just to control specific single permanent magnets, but also magnetic assemblies and their resulting field intensities and distribution, which is one of the most important things to control if these assemblies interact within the setup.

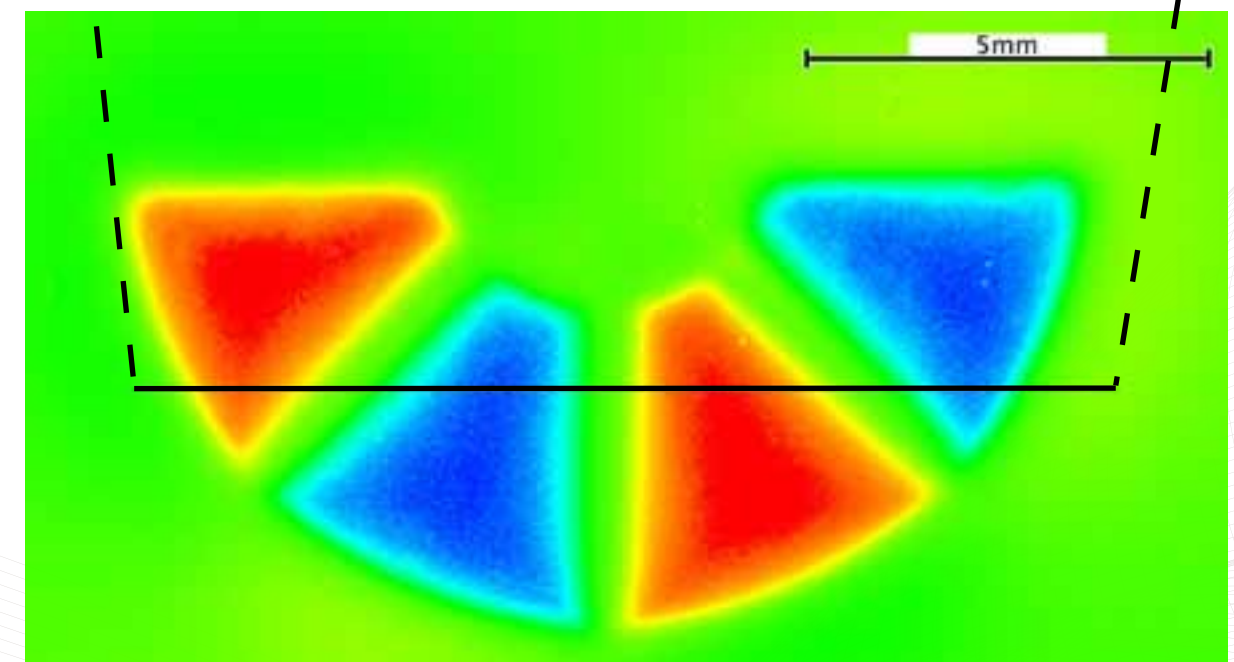
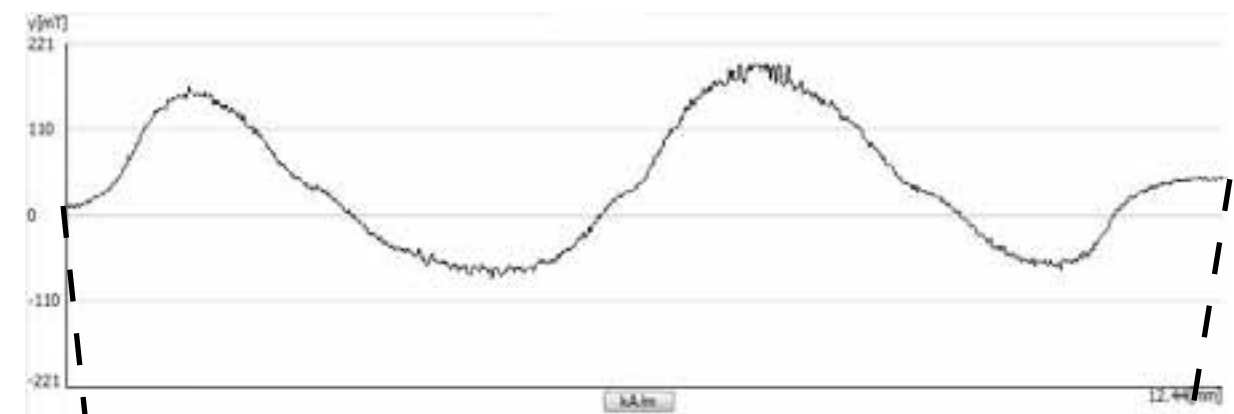
When visualizing magnetic fields with magneto-optical systems it is also a significant advantage that the magneto-optical wafers are imaging the field distribution and intensity continuously and therefore enabling the option to investigate dynamic magnetic processes as magnetization, remagnetization and demagnetization processes in real time.



Strongly related to measurements of dipole magnets, also multipole permanent magnets can be visualized and measured. Especially in electric motor, electric generator and alternator industries the growing demand for a reliable and decisive quality control system matches perfectly magneto-optical systems' capabilities.

Magneto-optical inspections do provide the huge benefit due to their areal imaging feature, which opens an innovative procedure in order to control rotors' surface-magnetic field - consuming just a minimum of time and efforts.

The specialized CMOS-MagView rotor setup is modular adjustable to different rotor diameters, lengths and also - by using different magneto-optical wafers - magnetic field intensities. With the specialized rotor measurement setup, magneto-optical wafers are integrated into an easy to use and very fast quality control system to check different geometries of rotors with one single device.





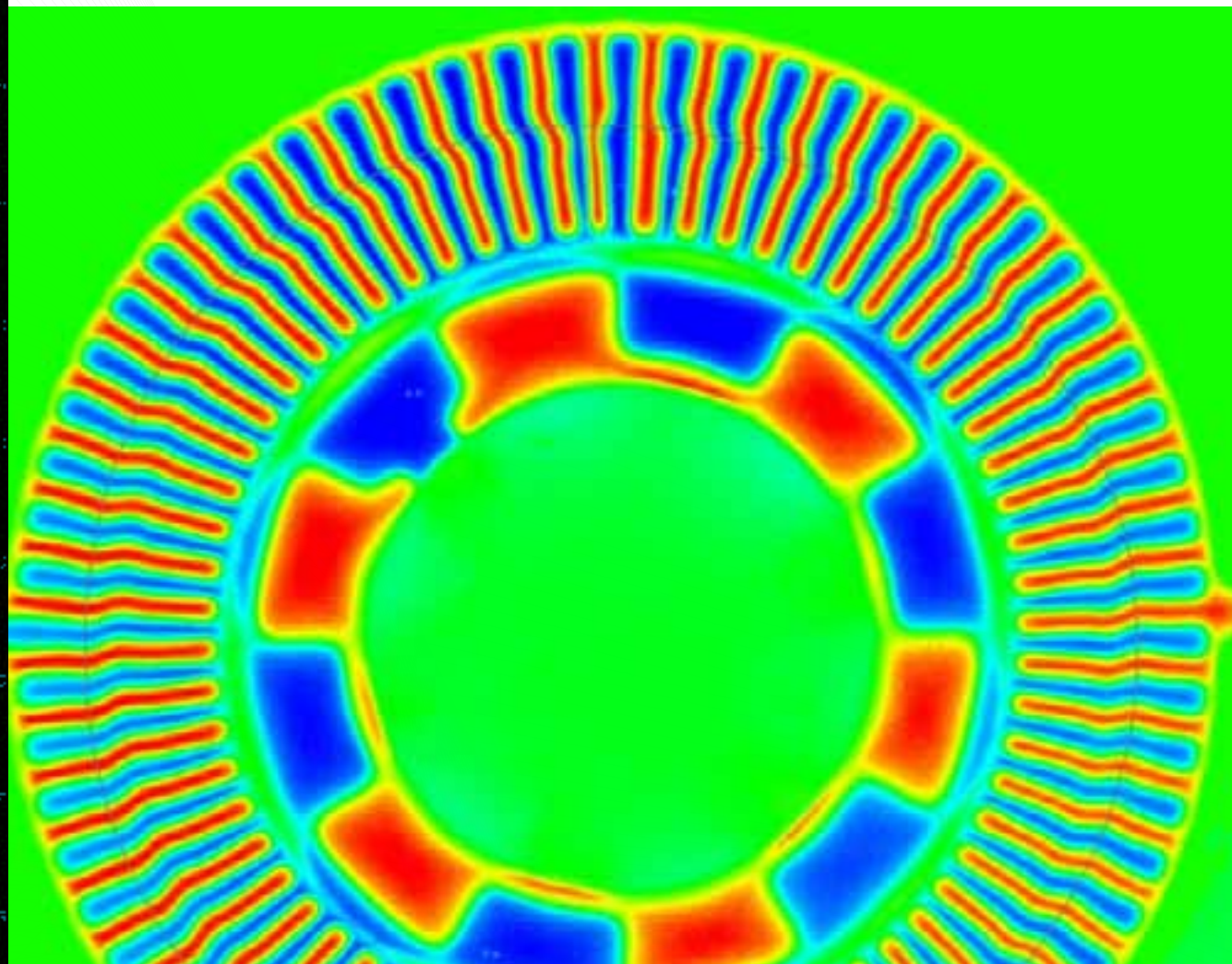
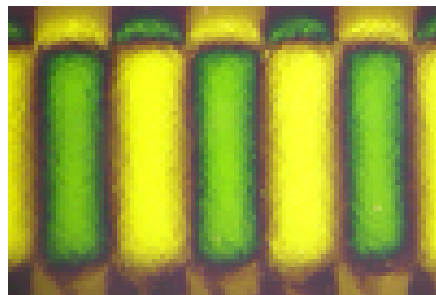
## Linear and rotary encoder quality control

A linear or rotary encoder is a sensor, transducer or readhead paired with a scale that encodes position or angular rotation. The sensor reads the scale in order to convert the encoded position into an analog or digital signal, which can then be decoded into position by a digital readout controller. The encoder can be either incremental or absolute. Motion or rotation can be determined by change in position over time. Linear encoder technologies include optical, magnetic, inductive, capacitive and eddy current.

While linear encoders are mainly used in metrology instruments, motion systems and high precision machining tools ranging from digital calipers and coordinate measuring machines to stages, CNC-Mills, manufacturing gantry tables and semiconductor steppers, rotary encoders are of growing demand especially in electrical motor industries and therefore electrical mobility.

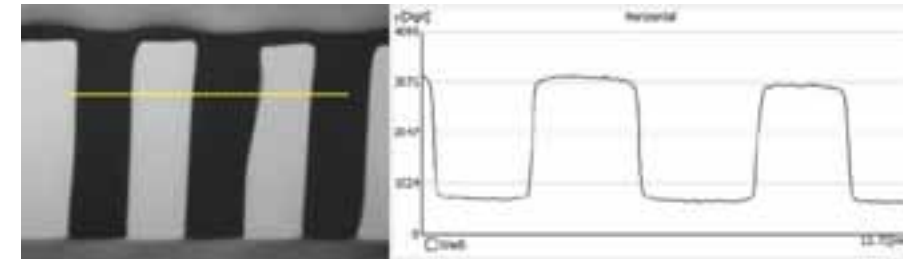
In order to provide best measurement capabilities of the used linear or rotary encoders it is necessary to control and check the quality of the installed magnetic encoder band and its magnetization qualities.

The MagView and CMOS-MagView can be used to assure geometric as well as magnetic properties of all types of magnetic encoders.



### Geometric quality control of linear encoder tapes:

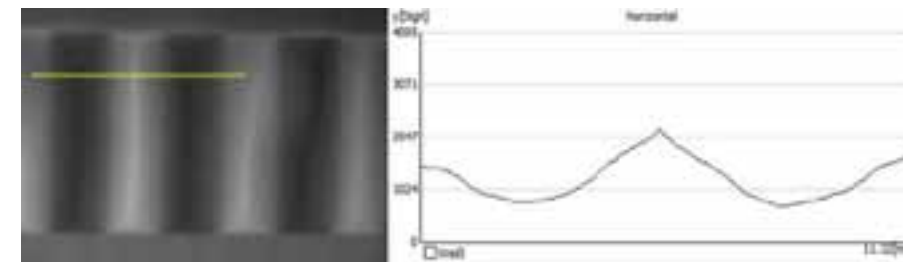
In order to measure and visualize the geometric pattern of magnetic linear encoder tapes the CMOS-MagView or handheld MagView is supported with a magneto-optical wafer type A working in clipping mode. Therefore hard magnetization boundaries can be identified and analyzed very easily and on demand automated for 100% production control.



Encoder with geometric failure clearly visible in MO-image and analysis chart

### Quality control of magnetic properties of linear encoder tapes:

In order to measure magnetization intensities or magnetization states of a linear encoder band a wafer of type B is commonly best suited. By using the CMOS-MagView evaluation software magnetization intensities can be measured precisely and the changes or uniformity of field intensity amplitudes can be controlled in real time.



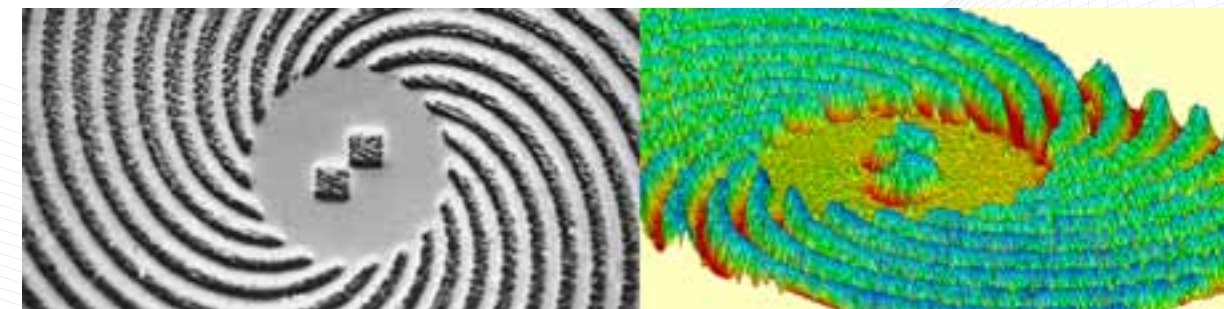
Measurement of magnetization intensities and amplitudes of encoder tape.

For comparison, green foil is not capable of identifying geometry defects. Furthermore there is no possibility of analysis of magnetic field intensities or pole orientation.



### Quality control of magnetic properties and geometry of rotary encoder structures:

A rotary encoder, also called shaft encoder, converts the angular position or motion of a shaft or axle to an analog or digital code. Rotary encoders are often used to track the position of the motor shaft on permanent magnet brushless motors, which are commonly used on CNC machines, robots, and other industrial equipment as well as electrical automobility motors. To ensure reliability and functionality of the motor product it is highly recommend to check rotary encoders regarding to magnetization geometry as well as intensity.



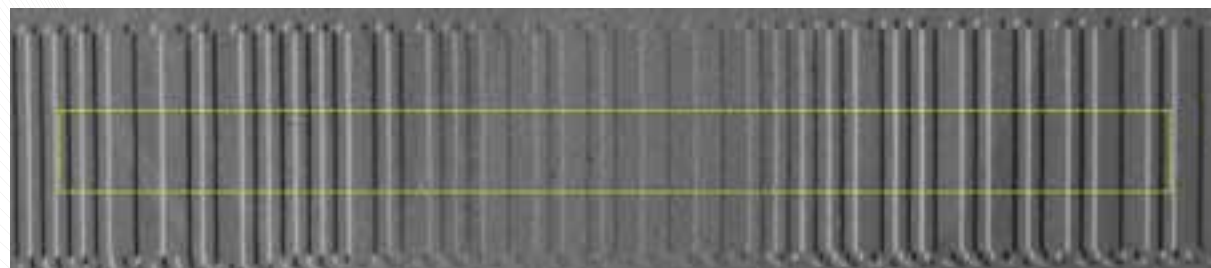
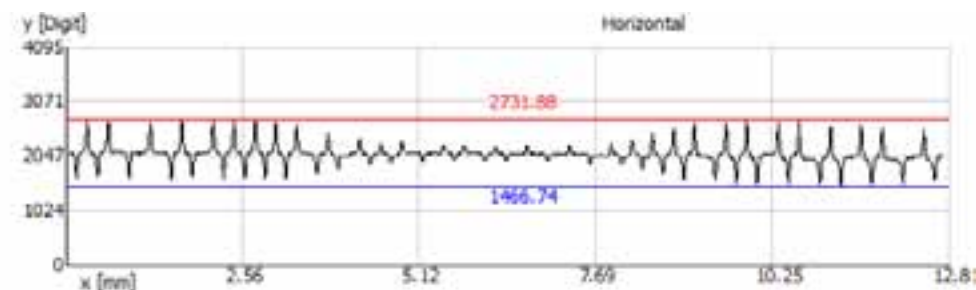
Visualization of magnetization structures and amplitudes of rotary encoder.



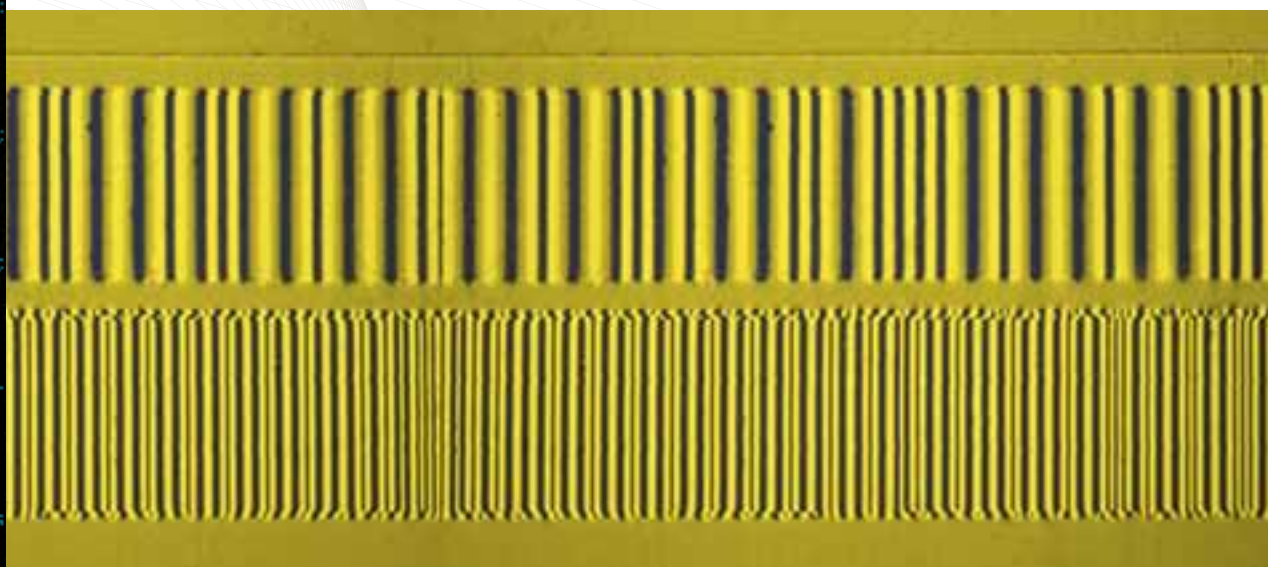
## Magnetic stripe card - quality and forgery investigation

A magnetic stripe card is a type of card capable of storing data by modifying the magnetism of iron-based magnetic micro particles on a band of magnetic material on the card. The magnetic stripe, sometimes called swipe card or magstripe, is read by physical contact and swiping past a magnetic reading head.

In order to identify magnetic structures magnetization quality magneto-optical sensor systems are the first choice for a quick and reliable 100% quality control. Due to significant marks even remagnetizations, frauding and other kinds of manipulations can be investigated within seconds.



Magneto-optical image of the magnetic code stored on a standard 3 track credit card. For quality control of geometrical information as well as amplitudes of magnetization intensities which are both functional relevant elements. Visualization and analysis can be performed in real time by CMOS-MagView or handheld MagView (without software post processing). Also defects and demagnetization effects can be investigated easily to determine a worn cards quality and ISO 7811's compliance (above card has been demagnetized in the center area to about 20% of standard intensity).



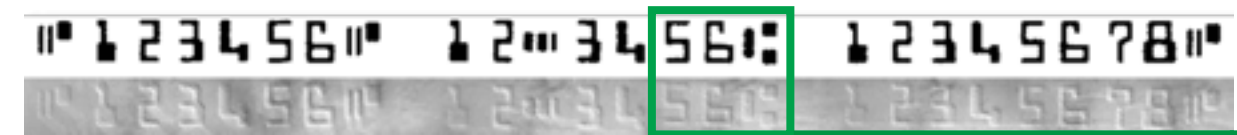
## Magnetic ink - quality control and fraud protection

Magnetic ink consists of standard ink plus additional iron oxide particles. These particles can be magnetized by an outer magnetic field to be analysed and read out. Therefore magnetic ink combines the visibility of ordinary ink with electronic processing and readout capability as well as fraud protection of magnetic particles.

Mostly used in the U.S. for cheque-transfer protection and processing the MICR - Magnetic Ink Character Recognition - is read out by using Hall probes in order to detect the unique waveform pattern of MICRs fontset standardized by ISO 1004:1995.

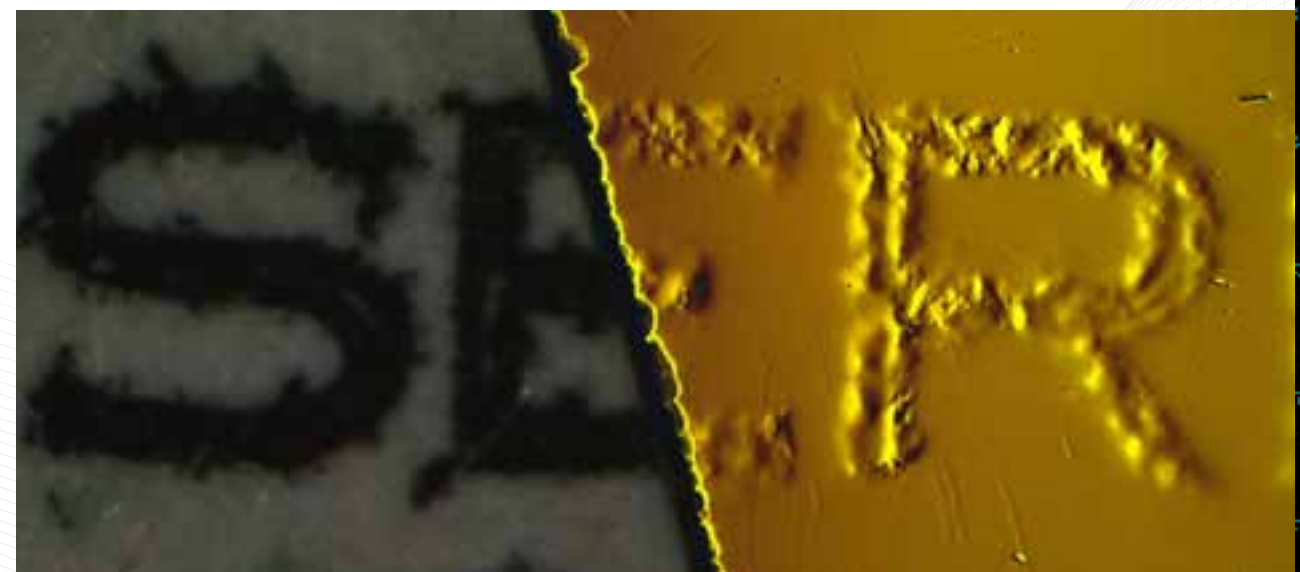
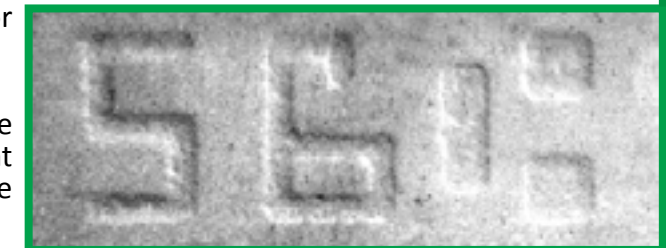
By using magneto-optical systems as the CMOS-MagView the huge advantage of MICR code - well printed MICR documents' "can't read"-rate is usually less than 1% while the substitution rate (misread rate) is in the order of 1 per 100,000 characters which is by far a smaller error rate as when using optical recognition systems - can be extended due to magneto-optical systems can be applied everywhere in real time.

Due to magneto-optical method's results are optical inspectable and processable, a time consuming computerized analysis of the magnetic field intensities (in order to assign each character's unique defined intensity pattern with the measured intensity pattern of the single cheque) is not necessary. Magneto-optical visualizations of MICR-compatible fonts can be evaluated and processed by comparison to the standard ink characters.



Comparison of standard MICR-fontset sample: upper row shows optical recognizable characters, while bottom row shows magneto-optical visualisation of the magnetic field intensities of magnetic ink used in for MICR-compatible printing.

For a better impression of the magneto-optical image quality the right picture shows a zoomed fragment of the upper MICR-fontset sample row.



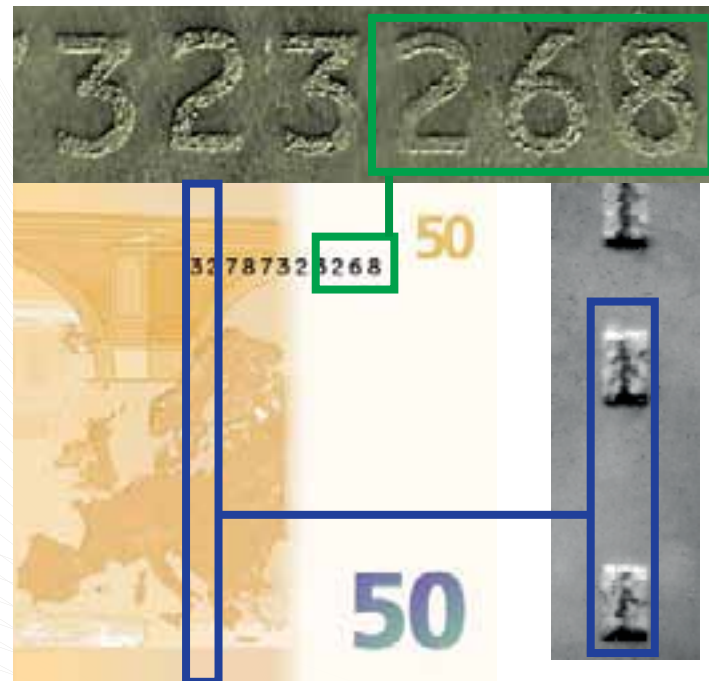


## Bank note magnetic safety signs investigation

Since nearly all leading currencies worldwide are using magnetic code to enable machine processing on the one hand (EURO) and/or to hinder forging of banknotes on the other, it is essential to check banknotes for their magnetic safety signs.

By use of magneto-optical systems it is possible to perform these checkups in realtime. While other checking devices can not - magneto-optical systems are capable of checking not just for the presence of magnetic information, but also to investigate the magnetizations quality, which might be an indicator of frauded banknotes.

Therefore different magnetic information can be visualized and analyzed. EURO banknotes for examples are beeing investigated regarding their magnetic ink serial number and the quality of the security thread. Contrary, U.S. DOLLAR banknotes have huge areas of magnetic ink printed security signs. Espeacially for areal investigations, magneto-optical systems are enabling a perfect quality control, as well as fraud protective method, due to their visualization capability in realtime.



Furthermore intensities of magnetic fields can be measured in order to identify even frauded banknotes that might be just identified by the quality of their magnetitization.

For laboratory investigations CMOS-MagView is the first choice, due to its capability of visualizing, measuring, protocolling and analyzing, while for mobile on-site checks the handheld MagView offers realtime checks without need for evaluation equipment.



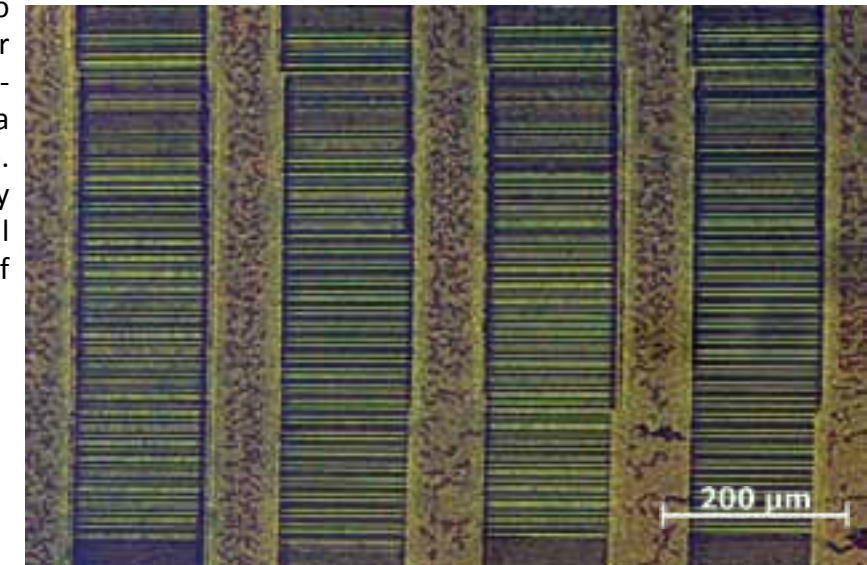
## Investigation of magnetic data carriers

### FD - Floppy Disks

The basics of floppy disk is a coated plastic disk. By changing the status of magnetization floppy disks are capable of storing binary data.

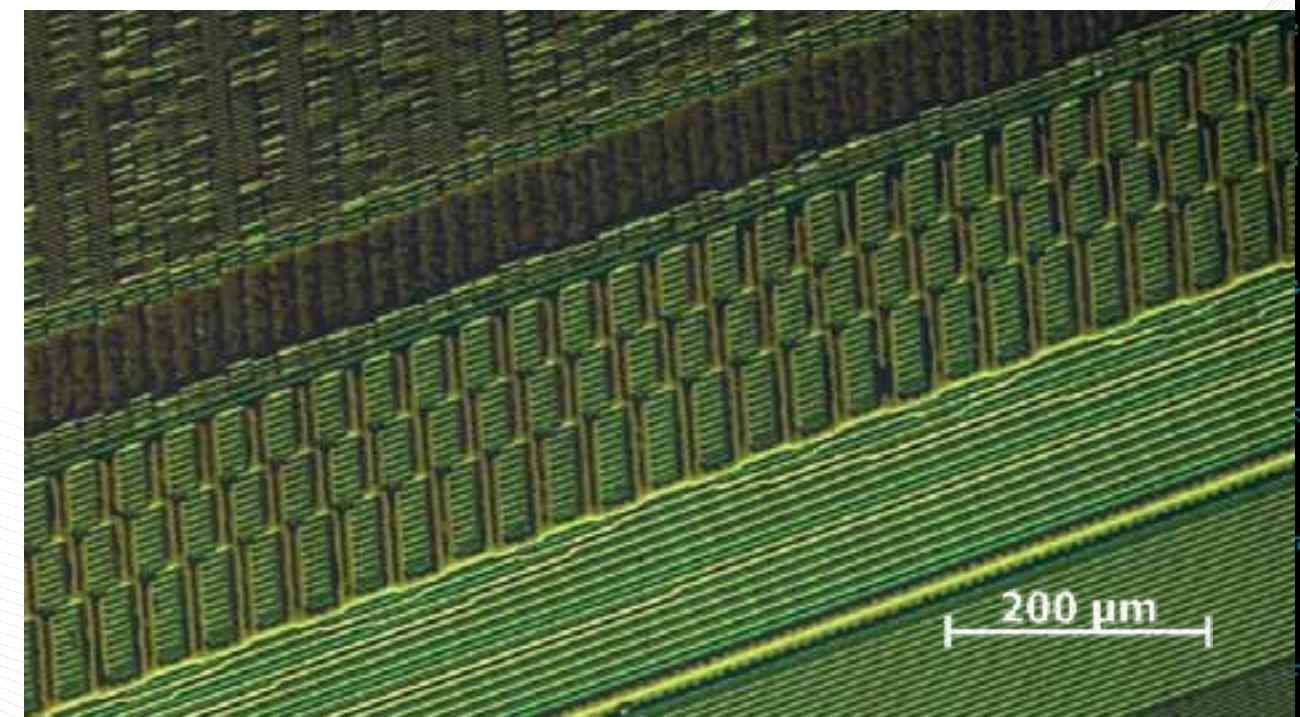
When using magneto-optical systems in order to visualize magnetic information on floppy disks it is possible to investigate damaged or forged floppy disks optically and additionally via image processing software. Additionally to Floppy disks, magneto-optical systems are also capable of analysing:

- IOmega Zip-Disks
- Sony Mini-Disk (Hi-MD)
- Olympus MO-Disk
- Sanyo IDPhoto Disk



### HD - Hard Disks

In addition to floppy disks' information also magnetic hard drives disks' information can be analysed using magneto-optical systems. Due to the possibility of an optical analysis and investigation, forensic applications of reconstructing damaged information is possible even when standard „disk read-and-write heads“ are failing. Magneto-optical systems are not just capable of visualizing standard hard disk drives, it is also possible to investigate for example IBM Microdrive Disks.





## Investigation of magnetic tapes

Magnetic tape is a storage medium for magnetic recording, made of thin magnetizable coating on a long narrow strip of plastic. Regarding to their form of usage magnetic tapes are commercially available as video, audio and data tapes.

Especially for forensic investigations of magnetic audio- /video- and data-tapes gain a huge advantage when using magneto-optical systems. They provide the possibility to clearly identify traces of manipulation on magnetic tapes, for example on audio tapes, which have clearly noticeable lift-off and drop-down marks when being rewritten or manipulated.

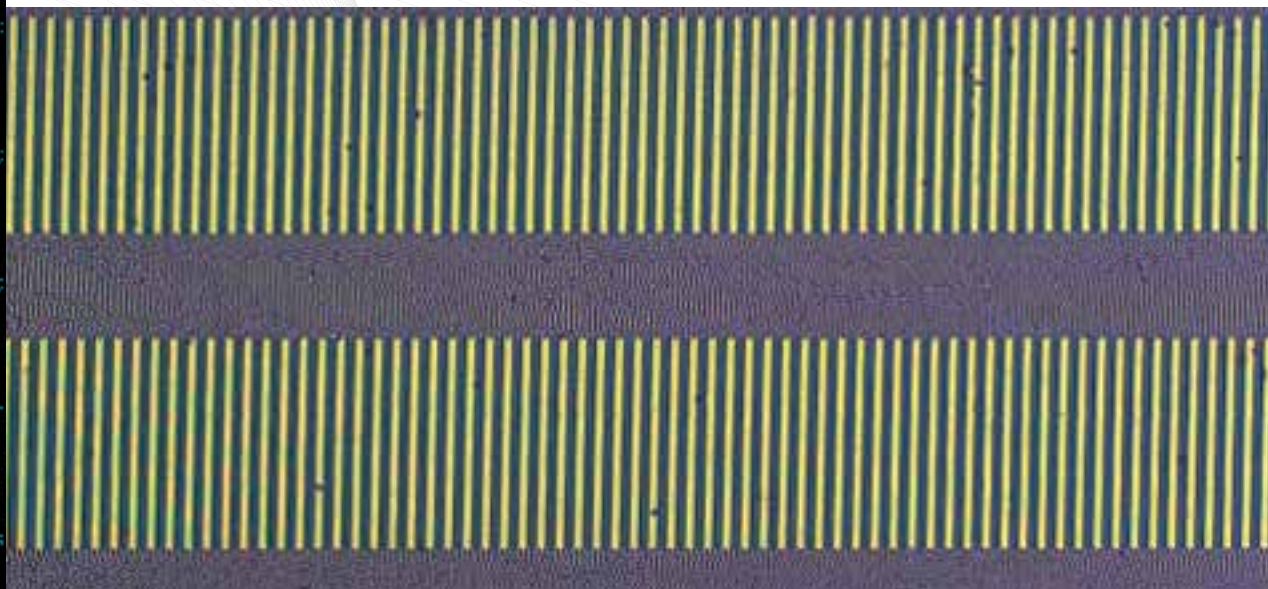
Sometimes these marks are audibly recognizable, but mostly there is still the need for verification, for example for trials. With magneto-optical inspections these marks can be made visible and can be proven from a technical viewpoint.



Another, not the less important application, is the reconstruction of damaged magnetic tape. When using magnetic tapes it should be clear that its re-readability and re-writeability is mostly defined by the quality of single magnetizations. Especially when using a tape very frequently, the lifetime will decrease extremely, due to an intense wear of the tape. Also when just storing magnetic tapes for long times the „sticky-shed syndrome“ is a well known problem.

Additionally to these ordinary forms of wear, magnetic tapes are often used in very rough conditions, where other forms of damage can not be excluded at all. When thinking of magnetic tapes used in flight recorders (also for Flight Data Recorders / Cockpit Voice Recorders) or also in space (due to their higher resistance to cosmic radiation) it is obvious that magnetic information structures are affected by several forces of destruction as physical force, heat and fire and also radiation.

Tapes exposed to these forms of destructive forces have a special need for extremely sensitive handling in order to keep the remaining information in best possible quality. In addition mostly they are no more reconstructable by magnetic measurement probes due to important parts of the data being damaged. By optical analysis of the remaining information, the tapes can be handled as carefully as possible. Furthermore there are often traces of magnetic information which automated probes are not capable of identifying. Here magneto-optical systems are capable to provide new techniques for investigation and reconstruction.



## Recovery of obliterated serial numbers

There are different techniques for the restoration of erased marks in metals. Due to non-destructive methods are always preferred, magnetic restoration methods are generally the first-choice method.

Using magneto-optical systems in order to restore obliterated serial numbers on vehicle identification numbers (VIN) and firearms offers a huge quality advantage compared to magnetic particle inspections and also compared to etching methods (which are not preferred at all due to their destructivity to the investigation material).

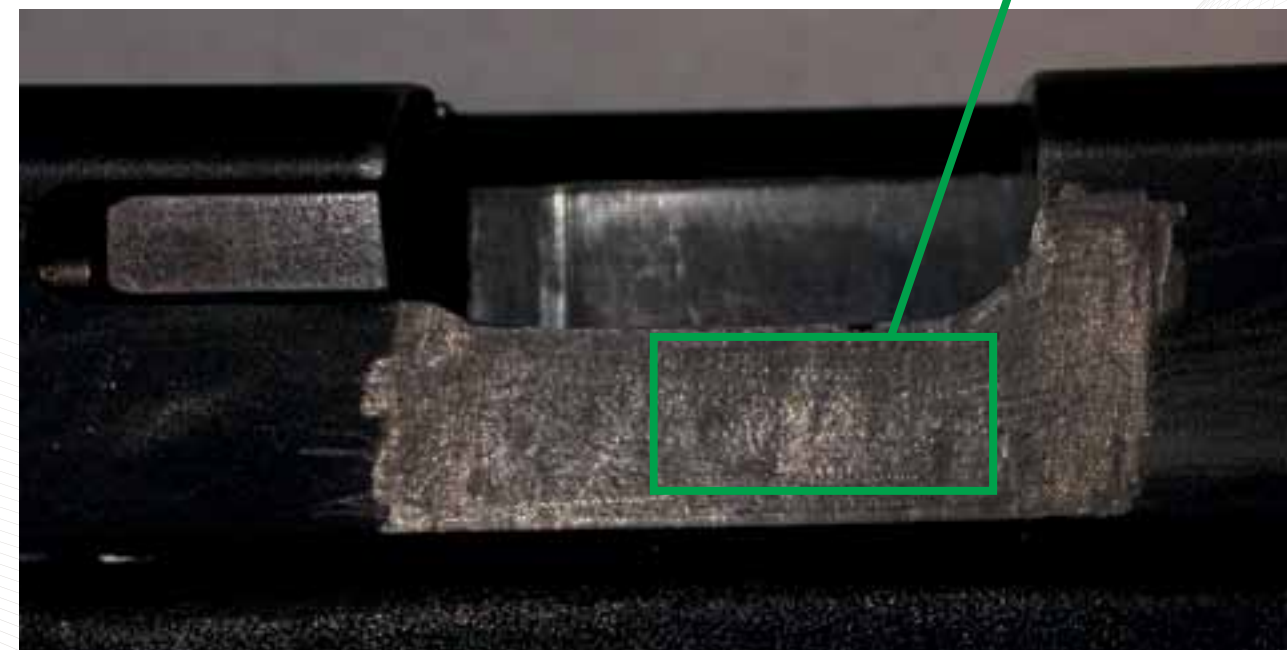
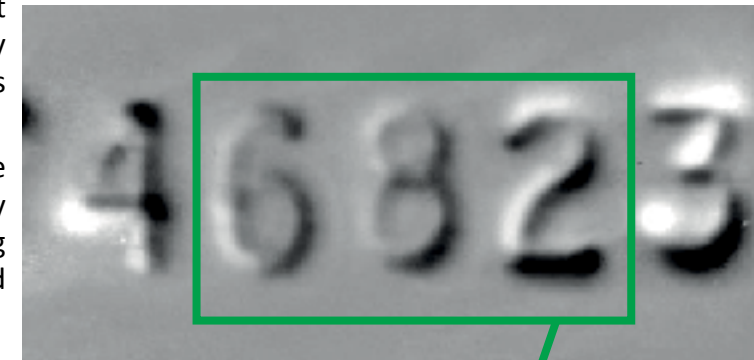
Several material examinations have been performed with steel sheets from automobiles, firearms, cast iron and stainless steel.

With regard to material analysis via magneto-optical systems with additional alternating field module, it is also possible to investigate obliterated serials on aluminium and other current carrying materials.

When investigating obliterated serial numbers on vehicles, it is possible to check the VIN itself, if it was just ground off. Another big advantage is that it is possible to check with the same magneto-optical system for welding seams near the VIN-number (see welding seam inspection for further information). Nowadays more and more VIN-numbers are not ground off, but are cut out and then being replaced and precisely welded into other vehicle frames.

So magneto-optical systems are perfectly suited to identify frauded as well as re-welded VINs and serial numbers on firearms. It is furthermore possible to identify re-welded plates of serial numbers with one device.

So especially for car dealers the MagView handheld is a necessary device in order to prevent buying stolen or manipulated cars and therefore to prevent crime support.



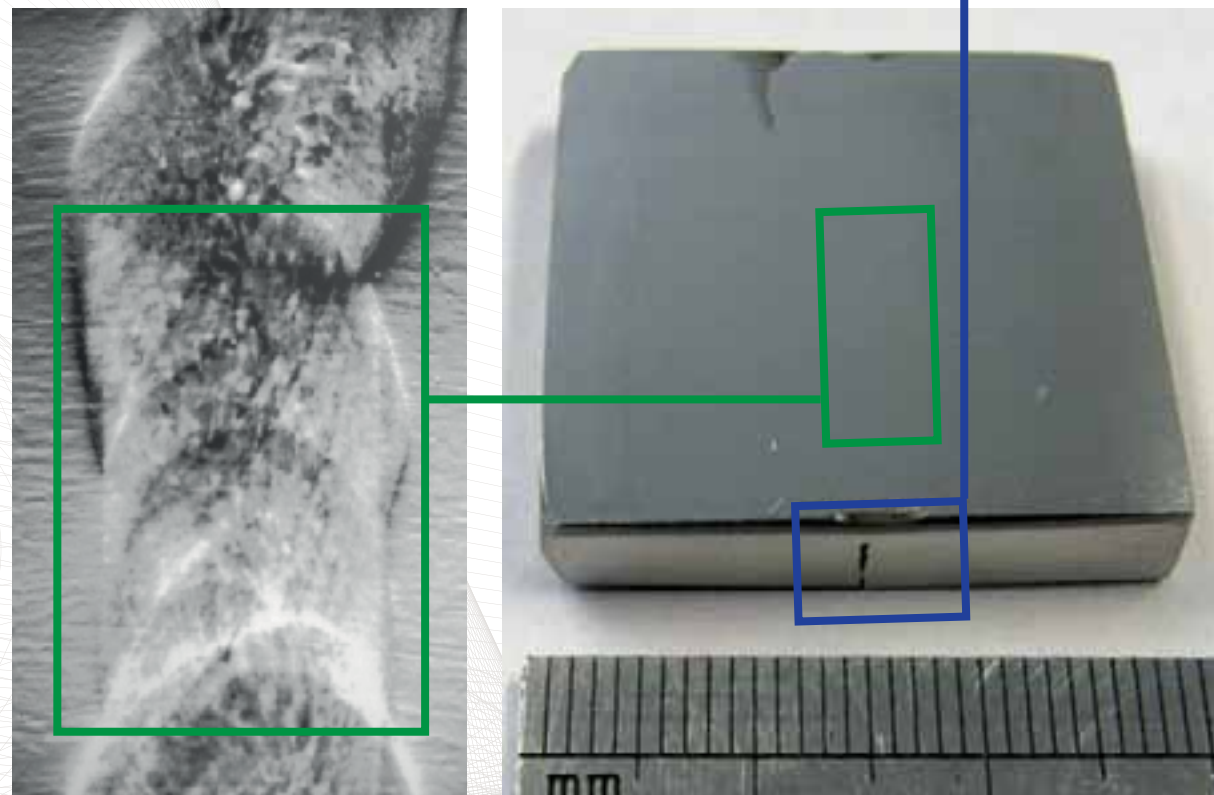
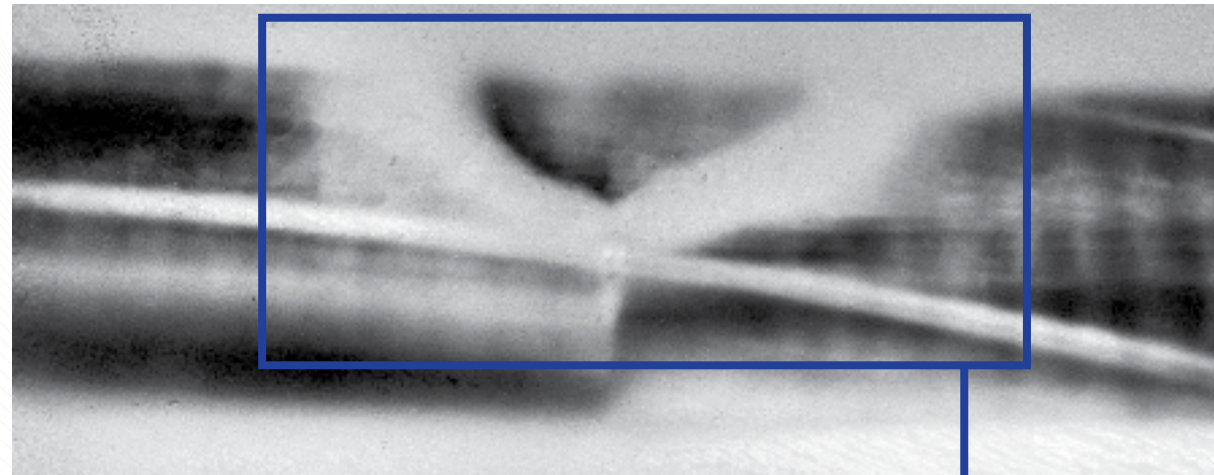


## Welding seem quality inspection

In order to provide weldings with best functional characteristics a highly accurate and precise welding seem is necessary.

The quality of a welding seem is mostly defined by its homogeneity. This means that all kinds of distortions must be identified and qualified whether they influence the structural integrity of the welded piece or not. The task is to identify inhomogenities, caused by encapsulations of air for example and to check these spots for their relevance.

While Ultrasonic-inspections are very time consuming as well as expensive, magneto-optical investigations are capable of generating a two dimensional cut through the magnetic field (either own field of the specimen or alternating external applied magnetic field) in real time. The result of the magneto-optical analysis is an real time image of the subsurfacial material characteristic for instant optical evaluation as well as for computerized processing and recording.

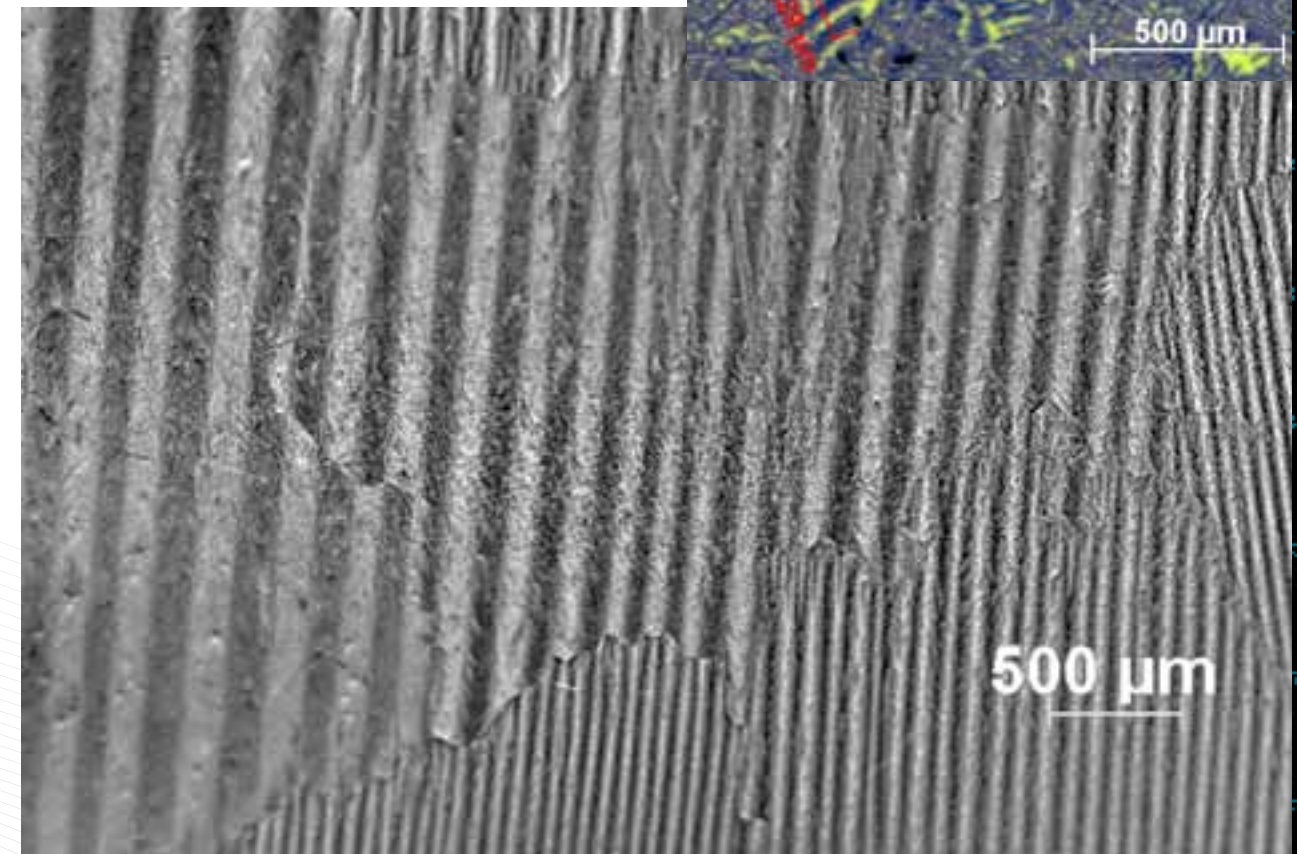
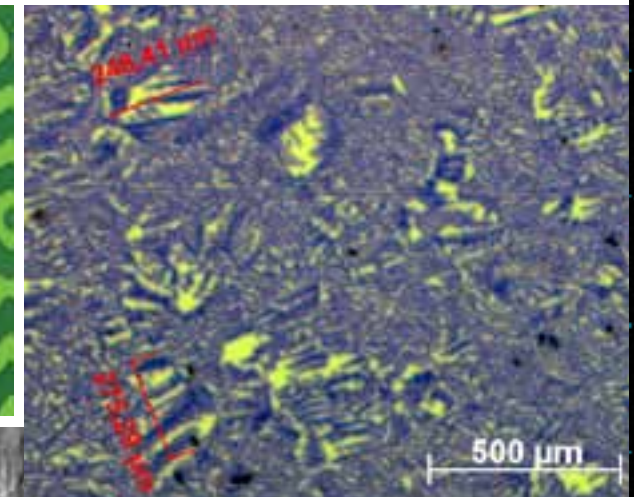
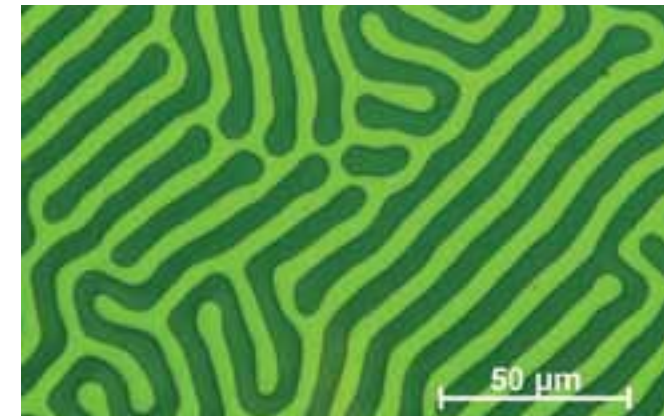
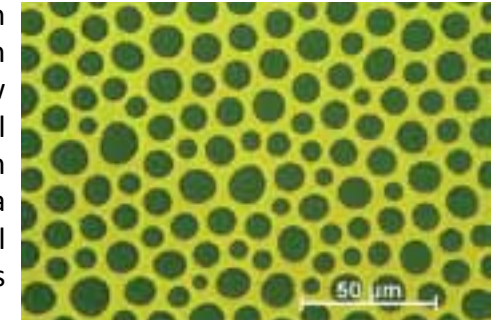


## Scientific research of magnetic materials and domain structures

Magnetic investigation of magnetic and non magnetic materials can be performed with magneto-optical systems in order to identify raw materials properties for example for metallographical applications. Thereby a realtime investigation of thinfilm samples regarding their domain microstructure offers a wide field of benefits for prospectors, quality control within manufacturing industries as well as for producers of magnetic materials.

Besides these, magneto-optical domain analysis can be used to easily characterize and analyze oriented as well as non oriented electrical steels.

(Top: Magnetic Bubble Domains; Below upper left: Magnetic Meander Domains; Below upper right: Non Oriented Electrical Steel Domains; Bottom: Oriented Electrical Steel Domains)







Ringmagnet with subsurfacial crack



10 Dollar Note „Hamilton“



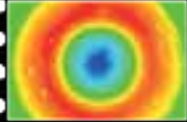
Domain analysis of shape memory alloy



Sikhote-Alin iron meteorite domain analysis



Compact Cassette with 1 kHz signal



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