

Holographic recordable polymers *

PhenoStor® - High-security storage media on ID cards for biometry applications

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Biometric systems are changing the face of security. However, the possibilities for electronic chip cards are limited. The new plastic storage medium PhenoStor® could solve the current problems.

Introduction

Show me your finger and I'll tell you who you are. Biometry is taking over everyday life. To identify yourself at the airport, at your workplace or at an ATM in future, not only will you be scrutinized, but you will also have to undergo a measurement procedure.

The spectrum of more or less successfully tested systems based on identification by means of physical features ranges from fingerprint comparison and iris scans to vein-pattern and face recognition.

1 Demand for secure, decentralized data storage media

However, a central collection of comparative data causes headaches not just for data protection personnel. It is also time-consuming and requires contact with the database every time a check is performed. Decentralized solutions therefore seem to be preferable. Biometric data is stored on a document (e.g. an ID card) that the person carries with them. A scan is performed to check whether the physical features match the data stored on the document.

The technical and security requirements are high. Whether it's a passport, a company ID card or a season ticket for a sporting event, the more detailed and comprehensive the biometric data used, the more storage capacity is required by the transportable medium on which this information is held. It must be secure against forgery and the data must be pro-

tected against unauthorized copying and tampering and must also be inaccessible to unauthorized persons.

In this regard, concerns relating to data protection law and acceptance problems with ID card users result not just from the potential risk of misuse or passing on of biometric information by the authorized test centers, but also from a lack of confidence in the security technology. "The assurances given regarding the benefits and security of biometric systems are only partially fulfilled by the technology currently available," writes the Federal Commissioner for Data Protection on his website [Bfdi05].

2 Increasing need for storage capacity

Current projects normally use electronic chips, which are limited in their capacity. Simultaneous storage of multiple biometric data is only possible if compromises are made in terms of resolution or the number of features recorded. The imprecision caused by this often leads to high "false acceptance rates" or "false rejection rates". This results in the checking system authorizing the wrong person or turning away the right person. The situation is the same when using templates on which the biometric features are stored not as an image but in coded form. The greater the information content of a template, the better the acceptance rates and the more capacity is required for storing the data.



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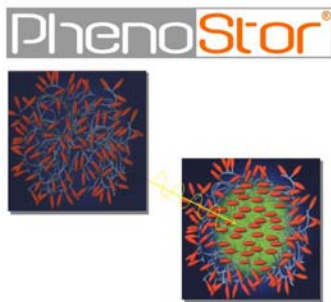
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* Englisch Translation of DuD-Article 'Holographisch beschreibbare Polymere', DuD • Datenschutz und Datensicherheit 30 (2006) 9

3 Holography as a basis for secure and high-capacity storage media

The storage medium PhenoStor[®] now offers a conceptual alternative to conventional, chip-based systems thanks to its far greater storage capacity, robustness and additional security against data tampering and data theft.

PhenoStor[®] is a plastic, or to be precise a light-sensitive polymer. The molecules of the material are aligned by light beams and cause a local change to the refractive index [Pic.1]. In this way, data holograms can be written into the material enabling e.g. biometric information to be recorded and later read. Depending on the usage, the medium allows both the nonrecurring write process ("write once") and, as an alternative, the repeated write process ("re-write").



Pic. 1: Orientation of polymer by laser light

In practical terms, this means that information, e.g. a fingerprint, is first digitally coded, possibly digitally encrypted and then sent to an optical mask. Two light beams, known as the object beam and the reference beam, project the information onto the storage medium with the help of the mask, causing an interference pattern in the material resulting from the overlaying of the light beams. The molecules align themselves in accordance with the pattern thus obtained. The subsequent read process requires precisely the same reference beam as that

used when the data was written – otherwise the arrangement of the molecules cannot be recognized, not even under a microscope [Hari02].

This feature of the process is beneficial from a security point of view. Because the reference beam passes through an optical mask during the write process, the phase of the light can be partially changed, thus enabling optical coding of the data to be stored. This ensures that the data cannot be read without a correspondingly coded reader [Voe05].

As well as preventing the data being copied or tampered with, this also stops unauthorized persons from accessing the hologram data.

4 Benefits of holography

Compared with conventional chip technology, PhenoStor[®] offers exceptional storage density of around 3.5 Mbit/mm². This means that around 10 MB of data can be stored on the surface of a chip storage module. As a laminate coating, the form and size of the storage medium is, in principle, freely selectable.

The polymer is also temperature and moisture resistant and unaffected by electromagnetic radiation. Its robustness is further enhanced by an intrinsic feature of holograms: If a section ceases to be optically accessible due to dirt or scratches, the information as a whole remains available, albeit with reduced contrast. The data is also protected by a self-correcting code that can remedy errors to a certain extent [Voe06].

The flexible application of the material makes the new storage medium ideal for combined documents based on both biometry and classical identification criteria (photo, signature). These include passports, ID cards, driving licenses and workplace entry cards [Henn06], [Pic. 2].



Pic. 2: PhenoStor[®]-cards

PhenoStor[®] offers a number of benefits for these applications:

- While the process of integrating chips into these documents in the attempt to ensure a long lifespan is laborious, the PhenoStor[®] film is typically already an inherent component of an ID card.
- The reading process does not require RFID technology, but can be performed without wear and tear by inserting the document into the reader. This means that the unauthorized reading of a document, e.g. while it is in someone's pocket, is in principle impossible.
- The functionality of the documents can be extended as required. Should further applications arise over the course of a document's lifespan, the information required for this can be added at a later date.
- Thanks to the optical coding, the PhenoStor[®] multi-application card enables physical separation of multiple sets of data stored on the same medium because different areas are written independently of each other.
- As something of a side-effect, analog holographic data storage enables copies to be distinguished from originals. With chips, which basically process digital data, the difference between the original and a copy can only be discerned by means of complex electronic signatures. Copies of analog data, on the other hand, can be determined without a great deal of difficulty because of losses that occur during the copying process.

5 A new medium for new applications

Possible applications are not limited to ID checking, i.e. authentication or identification [Bund05], [Icao03]. Health cards and multi-purpose bank cards are also regarded as key potential applications. Comprehensive patient or customer data can be stored on a PhenoStor® storage card – which offers effective protection against data misuse or theft – and made available to authorized user groups. X-ray images for radiologists, blood pressure readings for internists, and addresses and places of birth for health insurance companies can all be stored and called up separately [Bmgs05]. The technology can be used in the same way to store e.g. the check account status at Bank A and information about deposits at Bank B – data that must be kept separate from each other.



Pic. 3: PhenoStor®-Reader-Unit

The PhenoStor® system is currently undergoing the certification process that this year is to include a security certificate based on "Common Criteria" with evaluation assurance level EAL 3, to be extended to EAL 4+ in 2007. At the same time, PhenoStor® applications are currently being piloted under test conditions by a number of customers, the aim being to create the right conditions for a technically mature system. [Pic.3].

Summary

All in all, PhenoStor® offers a multitude of new applications. The greater storage capacity in relation to today's systems, combined with the optical security features, enables new approaches in the field of identity management by opening up fresh possibilities (particularly in combination with biometry) that were scarcely feasible in the past, not least because of data protection aspects.

Bayer Innovation GmbH has developed the alternative storage medium PhenoStor® in cooperation with a range of companies and research institutes with expertise in optics, cryptography and security technology. It is based on a special polymer that allows information to be stored in an ultra-high-density format at molecular level and also offers protection against data tampering and theft. The technology includes not only the medium, but also the writers and readers.

Specification of Globally Interoperable Biometric Standards for Machine Assisted Identity Confirmation using Machine Readable Travel Documents: <http://www.icao.int/mrtd/biometrics/recommendation.cfm>

- [Voe04] Völkening / Jüngermann / Hupe: Security Applications based on Memory Intelligent Polymers, Publication for D-A-CH Security (2004)
- [Voe05] Völkening / Jüngermann / Hupe: 'Light sensitive polymers – a solution for the storage of large sensitive data on plastic cards/plastified cards', Publication for 9. Deutscher IT-Sicherheitskongress des BSI (2005)

Anmerkung / Remark

This article is also available in German on our web page 'www.phenostor.com'.

Literature

- [Bfdi05] Der Bundesbeauftragte für den Datenschutz und Informationsfreiheit: http://www.bfdi.bund.de/nn_533592/DE/Schwerpunkte/Biometrie/Artikel/BiometrieVorDemDurchbruch.html
- [Bmgs05] Bundesministerium für Gesundheit: Informationen zur elektronischen Gesundheitskarte: <http://www.bmgs.bund.de/download/broschueren/a415.pdf>
- [Bund05] Informationen der Bundesdruckerei zum Personalausweis / Reisepass: http://www.bundesdruckerei.de/de/iddok/2_1/index.html
- [Hari02] P. Hariharan: Basics of Holography, University Press Cambridge (2002) 1-2
- [Henn06] O. Henninger, D. Scheuermann, U. Waldmann: Usability of holographic data storage technology for biometric data in governmental ID documents, Fraunhofer SIT Darmstadt (2006)
- [Icao03] ICAO TAG MRTD/NTWG Technical Report Version 2.0: Development and