Digital Flight Label

The combination of cholesteric reflective bistable displays with HF-RFID has been used as digital flight label: The information related to the contents of trolleys used in aviation catering for the transport of high value items is transferred by RFID to a tag located on the trolley and is indicated on a bistable display attached to the trolley (figure 7).

7 *The use of cholesteric reflective bistable displays with wireless control via HF-RFID as digital flight label replacing paper labels on trolleys containing high value items for avionic catering*

Outlook

Concerning the extension of possible applications, bistable reflective cholesteric displays are currently installed in aircraft galleys in order to indicate loading lists which were so far delivered only as hardcopy. While the development of bistable reflective cholesteric displays based on rigid substrates is nearly completed, more effort is presently put on the development of displays comprising flexible substrates and of polymer/liquid crystal composites in order to improve the stability of these displays against mechanical distortions [1-3].

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[5] F. Kuschel, C. Boeffel, M. Bauer: SID 2002 Int. Symp. Dig. of Tech. Papers, 33, 554 (2002)

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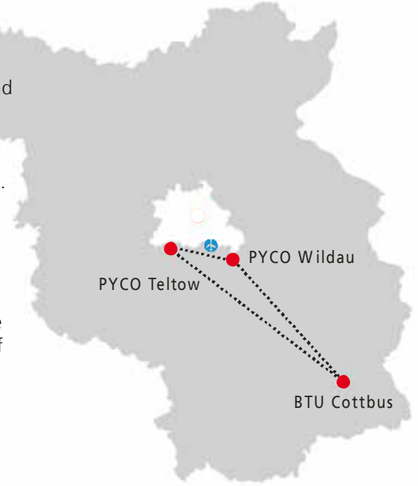
Location Berlin-Brandenburg

New solutions require new approaches: The location of the research institute in Teltow, where the metropolis of Berlin and the federal state of Brandenburg meet, offers optimal conditions for innovative scientific research. Here, the products of tomorrow emerge from ideas and visions. Therefore, the institute's scientists have formed a creative research network with renowned universities, well-known large-scale enterprises, and various innovative medium-sized companies. Additionally, new synergy arises from the integration in the third largest location of aerospace industry in Germany.



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Bistable Displays

Motivation

Bistable displays (e-paper) need only negligible amounts of energy in order to indicate information: Energy is required to write information, but not for displaying it permanently. Such displays are commonly reflective, i.e. sufficient ambient light enables one to read them. During recent years, Fraunhofer PYCO has put much emphasis on the development of cholesteric bistable displays employing stable phases of the cholesteric liquid crystalline phase for information display [1-5]. In particular, the advantage of very low energy consumption has been employed for combining these displays with various standards of wireless communication such as Bluetooth® and radio frequency identification (RFID) in the HF- and UHF-range. This combination offers a broad variety of applications ranging from the field of logistics to construction aspects of e.g. aircraft interior.

***1** Example of a bistable reflective cholesteric display*

Possible Applications at a Glance

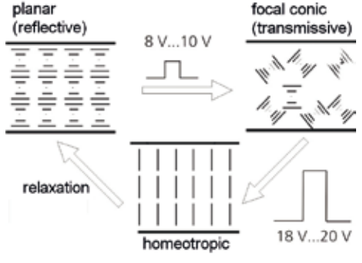
- Aircraft interior
- Logistics
- (Outdoor) displays for information and advertisement
- E-reader
- Updateable type plates

Display Properties at a Glance

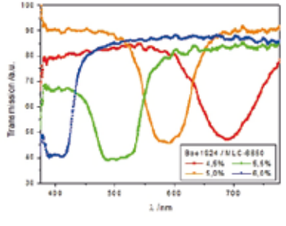
- Contrast ratio up to 10 over a wide range of the viewing angle
- Electrical fields: 5…7 V/µm
- Operating temperature: 0°C–70°C
- Storage temperature: -40°C–80°C
- Information is conserved more than 1 year
- Good stability against UV light
- Two-colored (e.g. black/green); other combinations are adjustable

Operational Principle of Bistable Reflective Cholesteric Displays

The principle of ChLCDs is based on the reversible electrical switching between stable textures of the cholesteric phase as shown in figure 2. Hence, it is possible to achieve a reflective and a transmissive state. The cholesteric phase is induced by doping nematic liquid crystal mixtures with chiral dopants. The color of the reflective state is adjusted via the dopant's concentration (figure 3) [4,5].



***2** Operation principle of bistable cholesteric reflective displays*

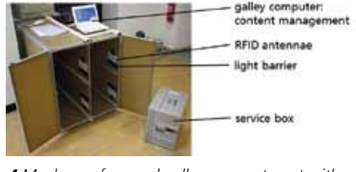


***3** Adjustment of reflection wavelength by the concentration of the chiral dopant*

Exemplary Applications of Bistable Reflective Cholesteric Displays

Displays in Galley Doors to Ensure a Flexible Content Management

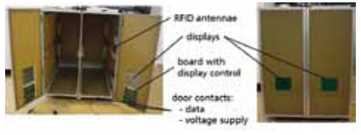
The operators of galleys in aircrafts are confronted with the problem that the contents of galley compartments (e.g. meals) changes during a flight. In order to ensure rapid catering routines and hence a high comfort for passengers, the crew needs at any time immediate access to the present galley's inventory. Furthermore, novel galley construction schemes envisage moving compartment doors so that one door closes different compartments over time.



***4** Mock-up of a novel galley compartment with galley control unit*

Cholesteric reflective bistable displays in combination with service boxes bearing RFID tags, with RFID readers and light barriers installed in the compartment's side walls and with a galley control unit (figure 4) enable an auto-adaptive monitoring of the galley's inventory:

- When inserting / withdrawing service boxes, RIFD readers and light barriers deliver information concerning the contents and the direction (in/out) to the galley control unit.
- The information is transferred via USB from the galley control unit to the bistable door displays (figure 5) indicating at any time the actual inventory of the compartment behind the door.
- The information is also displayed when the doors are open and the energy supply is interrupted.



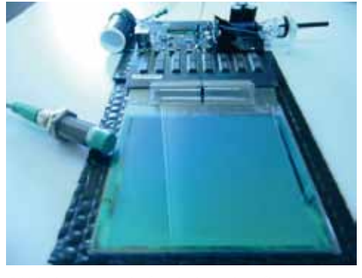
***5** Mock-up of a novel galley compartment with bistable displays integrated in the doors*

Bistable Displays with Wireless Control for Logistic Applications

The low amount of energy needed to operate these displays enables one to control these displays in a wireless way. Fraunhofer PYCO has developed such controls for the following wireless standards:

- **HF-RFID** (13,56 MHz; range: 0…10 cm; wireless energy transfer: 15 s are needed for a single writing of a 160x160 pixel display; cf. figure 6)
- **UHF-RFID** (860 MHz; range: up to 2 m)
- **Bluetooth®** (2,4 GHz; range: up to 5 m inside buildings)

In particular, the combination of a bistable display with RFID allows for replacing paper-based one way solutions such as barcodes in many logistic applications. Moreover, the information indicated on the displays is immediately accessible without further hardware such as RFID-readers.



***6** Wireless control of a cholesteric reflective bistable display via HF-RFID and with wireless energy transfer via inductive coupling*

BISTABLE DISPLAYS