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Whitepaper

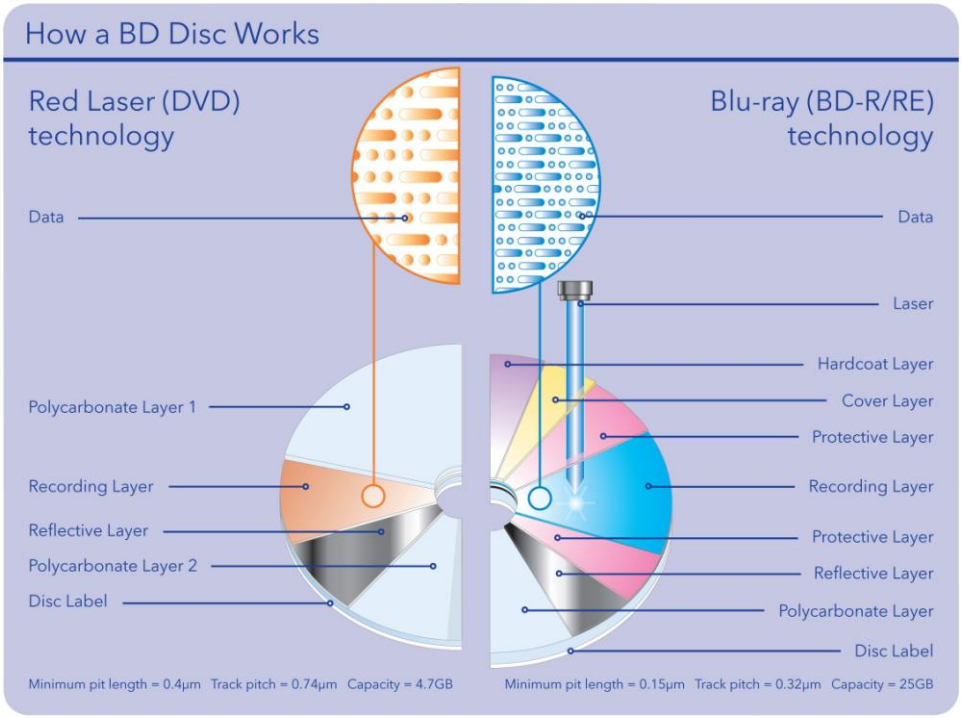
Blu-ray – new technologies and market trends

(Published: June 2010)

"What is Blu-ray?"

Blu-ray is an optical storage medium that was initially developed to host High Definition (HD) content. Its main use is storage of HD video, HD games, archiving and storing data of any kind. Blu-ray offers 25GB capacity per layer, 50GB in two layers being available as well. Higher capacities are in development, with 100GB and 128GB expected within 2011.

Blu-ray discs come in the same form factor as DVD & CD, typically 12cm diameter with a thickness of 1.2mm. The initial developers of Blu-ray were Sony and Philips, with the first specification set in 2004. However, it took until 2006 before the first Blu-ray burner became available.



Blu-ray got its name from the blue layer (ray) that is used for reading and writing the BD discs. Today the usual optical formats are available in Blu-ray, such as BD-ROM (Read only), BD-R (Recordable once) and BD-RE (Re-Writable), all in 25GB and 50GB capacity.

Today in Europe, Blu-ray burners for computer use are more available than Blu-ray video recorders where first systems were launched in 2009. Blu-ray hardware is typically backwards compatible to DVD and CD, both in playback and write functionality.

Key Applications of Blu-ray

Blu-ray discs feature several key applications. Initially it was developed for HD recording which can feature television recording, camcorder archiving or HD video distribution. Today this is still one of its main applications, but others have evolved as well, mainly within the computer area.

- Blu-ray is regarded as a key optical storage and archiving media, not only for professional archiving in optical libraries or offline storage, but also in private usage, e.g. for storing private photos, videos or other important data like financial records.
- Professional archiving may include storage of medical records, R&D records within the industry, catalogues and audiovisual assets.
- Blu-ray media may serve as an offline storage for the most important data usually kept on NAS systems. Here it has the advantage that the media can be stored in a different location giving additional security in case of an accident or a fire etc.
- For consumer and semi-professional usage Blu-ray offers big storage capacity with a low per Gigabyte price tag. Its high storage capacity in comparison to DVD and CD media results in far fewer discs being required to save large volumes of data
- Another application gaining greater importance is content distribution using duplication equipment. Blu-ray discs with inkjet or thermal printable surfaces allow duplication on recordable media for small-scale distribution of videos, company presentations, software or other data needed in multiple copies.

Hardware

Blu-ray players have become a mainstream seller in most of Europe with prices starting below 100€. However, they are still outnumbered by the huge sales of Playstation 3 which can be used as a Blu-ray player. Blu-ray video recorder sales started in 2009 in Europe with first launches in France and the UK, whilst Germany and other regions followed in 2010.

More popular today is Blu-ray equipment for computer usage. Many PCs and laptops are already pre-equipped with a Blu-ray Combo drive (BD player, DVD/CD writer) or even a Blu-ray writer. Various companies offer internal or external Blu-ray writers for upgrading older computers to the new standard. Prices for Blu-ray combo drives start well below 100€ whilst BD writers are still above the 100€ price mark.

All of these systems come with Blu-ray playback and/or recording software. It is expected that the hardware market will significantly increase in the near future.

Playback and recording Software

Software that supports Blu-ray is available from a number of vendors. This does not only include playback software or recording software. A variety of editing software for HD video content / camcorder recordings is available.

Blu-ray specifications

The Blu-ray standard is controlled by the Blu-ray Disc Association. This is an industry organisation formed by well over 100 members. Specifications include physical specifications as well as format and file standards specifications for media. Logically, hardware is also specified by the Blu-ray Disc Association, helping to ensuring strong compatibility between the media and the burners and players.

Specifications include the blue-violet laser wavelength of 405nm, the physical diameter of 12cm, groove recording, hardcoating etc. as well as the UDF 2.5 format used for recording, superior error correction system, video codec's, digital rights management, copy protection etc.

More information can be obtained from the official website of the Blu-ray disc Association: http://www.blu-raydisc.com/en.html

Different types of Blu-ray media

Blu-ray media comes in the three standard variations that are available in optical media. Blu-ray ROM is the read-only version that is used for distributing movies, videos, games or software. Blu-ray Recordable, or BD-R, is the write once standard. It comes in 25GB or 50GB capacities.

Today a number of recording speeds are available. Blu-ray Re-Writable, or BD-RE is the rewritable standard. It is also available in 25GB or 50GB capacities. Today mainly 2x recording speed is available. BD-RE is rewritable up to 1000 times.

- **Blu-ray Re-Writable BD-RE**

  BD-RE uses phase-change layers which are already well-known and proven in DVDRW and CDRW technologies. So it was a logical step to continue research in the existing phase-change materials and adopt it to the new laser wavelength of 405nm used in Blu-ray technology. Mitsubishi/Verbatim use the well known SERL recording layers based on eutectic semiconductor

materials. SERL is already proven to last a long time and stay stable for repeated recording, providing excellent readability again and again after rewriting. The disc can be re-written up to 1,000 times. BD-RE is mainly used for intermittent storage and test burns, e.g. for testing newly developed software, games, video, or to test a new hardware environment. Due to the rewritability it provides cost and ecological advantages against write-once media.

- **Blu-ray Recordable BD-R**

  BD-R is the WORM (Write Once Read Many) format of Blu-ray. BD-R is the main product used in recordable/rewritable Blu-ray. Its main usage is archival and distribution of video, games, software or any other kind of data. In the early stages of BD-R development inorganic material like Metal-Nitride, Tellurium-Oxide or Silicon-Copper alloys were favoured for usage as the recordable layer. Common to all of these materials is the fact that their reflectivity/polarization changes from a HIGH to a LOW status after recording, hence they are commonly known as HTL BD-R. Today these materials are still used by a number of manufacturers; both for single layer 25GB and for 50GB dual layer BD-R. The first Blu-ray specifications set the standards for HTL media. BD-R HTL media is manufactured similar to RW media like DVDRW and CD-RW using sputtering equipment. This is an expensive and wasteful process. Use of existing DVD manufacturing equipment is limited due to the small available quantity of sputtering machines that are only used for RW DVD and RW CD production.

Verbatim Blu-ray with AZO Recording Layer

However, in CD-R and DVD-R production organic materials like AZO or Phtalocyanine dyes are the proven recordable layers for write-once media. Organic materials combine all the advantages of inorganic recording layers with the major advantage of proven and cost-effective manufacturing. So the pioneers of organic recording material immediately started research in this field. Mitsubishi/Verbatim, the leading company in this field, combined efforts with the hardware manufacturer Pioneer, and in 2007 presented BD-R using organic recording layer.

CD-R AZO DVD-R AZO BD-R AZO

(Dye in solution. Colors depend on the tuned absorbance peak for read/write laser-diode wavelength for each generation, i.e. Infra-read-780nm, red,-660nm and blue-violet-405nm)

Organic BD recording layers change their reflectivity / polarization from a LOW to a HIGH status after recording. This new standard called LTH Type was adopted by the BDA immediately. By late 2007, burners and video recorders supporting LTH Type media were in circulation and SONY's Playstation 3 was made compatible with the firmware update 2.20 in March 2008. Support for LTH Type BD-R became

mandatory in late 2008, so that today all new Blu-ray hardware must support BD-R LTH Type.

Difference in "HTL" and "LTH" media

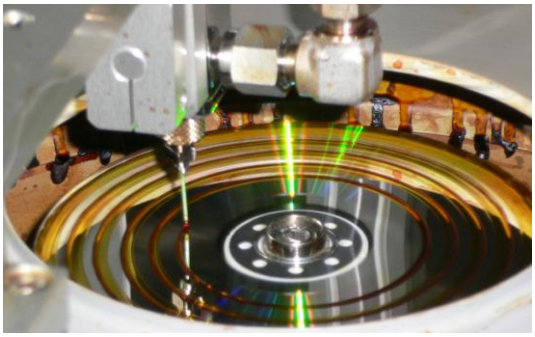
	HTL	LTH	Impact on existing BD drives
Technology	▪Mainly inorganic ▪Sputtering process (higher facility cost)	▪Mainly organic ▪Spin-coating process (lower cost)	-
Data Signal Polarity	High to Low	Low to High	Big but easy implementation to electronics
Reflectivity of High level	12-24%(unrecorded)	16-35%(recorded)	Small Only gain control
Recording track (tracking servo signal polarity)	On-groove	In-groove	Big but easy implementation to electronics
Push-Pull (tracking-servo signal amplitude)	High unrecorded, Big reduction after recording	Relatively low, and small change after recording	Big on Recording and complicated for both of optics and electronics

Mitsubishi/Verbatim promotes BD-R LTH Type together with other companies in the market. Soon after its launch, BD-R LTH media achieved a significant share of the total BD-R market. Intensive testing proved that this type of media, well proven optical technology for nearly 20 years, provides high quality recording, interchangeability and archival lifetime.

BD-R LTH media offers the consumer a significant price advantage over HTL media. This is due to two facts:

1. The manufacturing process of LTH Type media is simpler and more cost effective. This is similar to DVD, where DVDRW always cost more than DVDR media.

2. A significant part of the "waste" generated by LTH Type manufacturing can be recycled, which is more eco-friendly, and provides a cost saving.

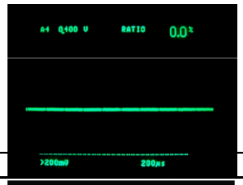
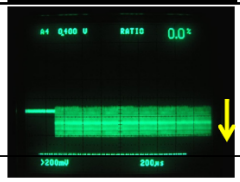


“Spin_coating process of LTH B-R recording layer”:
The dye solution is being dispensed from a nozzle). Spin-coating is the key process for LTH BD-R disc manufacturing, applied for the dye recording layer, cover-coat layer and hard-coat layer.

LTH Type media is manufactured in the so-called spin-coating process, so that many of today’s CD-R / DVD-R production lines are available for conversion into Blu-ray production lines. This provides an inexpensive process for quick and reliable production volume increases responding to rising market demand.

What is LTH and HTL?

- Low to High(LTH) and High to Low(HTL) correspond to the reflectivity change by recording, resulting the opposite signal polarity.
- LTH and HTL are based on a nature of the inorganic and organic recording layer material, respectively.

	LTH(Organic dye BD-R)	HTL(Inorganic BD-R/RE)
Unrecorded		 GND
Recorded		 GND

As briefly stated, compatibility with burners / video recorders and players is already high and is improving with every new piece of Blu-ray hardware launched. Most 2009 models support LTH Type media, whilst older systems are made compatible with a firmware upgrade provided by the manufacturer of the hardware. This can typically be checked on the manufacturer’s website and in various internet forums. Mitsubishi / Verbatim also offers information on its website regarding compatibility and required firmware versions for older models.

About the author

Torsten Leye is Optical Marketing Manager for Verbatim EUMEA. He takes responsibility for Business Development of the optical product segment, with strong focus on Blu-ray. He joined Verbatim in 2000 as Optical Business Development Manager and worked in several positions before moving to his new position in 2006. Mr. Leye, born in 1964, holds a degree in Electronical Engineering from Dieburg University, Germany. Before joining Verbatim he worked in the media duplication industry for more than ten years, both in sales and support.

Pictures an be found at:
http://newsletter.komm-passion.de/newsletter/verbatim/BD_LTH.jpg
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http://newsletter.komm-passion.de/newsletter/verbatim/Spin_coating1.JPG
http://newsletter.komm-passion.de/newsletter/verbatim/Spin_coating2.JPG

About Verbatim
Since 1969, Verbatim has been shaping the development of data storage technology – from Floppy Disks and Magneto-Optical storage media, CD and DVD formats to the latest High Definition media Blu-ray. Moreover, Verbatim offers high quality products in the field of Portable USB Drives, Flash Memory Cards, SSD and External Hard Drives in 4,57cm (1,8“) Pocket, 6,35cm (2,5“) Portable and 8,89cm (3,5“) Desktop-Format as well as a broad variety of computer Accessories. Verbatim is a subsidiary of Mitsubishi Chemical Group and benefits from the outstanding research and development department. With these innovations Verbatim has played a key role in shaping the storage media market. Ultra-strict quality controls during the manufacturing process ensure the high quality of Verbatim’s products, which have been the winners of numerous international comparative tests. The company is the worldwide market leader for Optical Media. For more information, please visit www.verbatim-europe.com.

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