



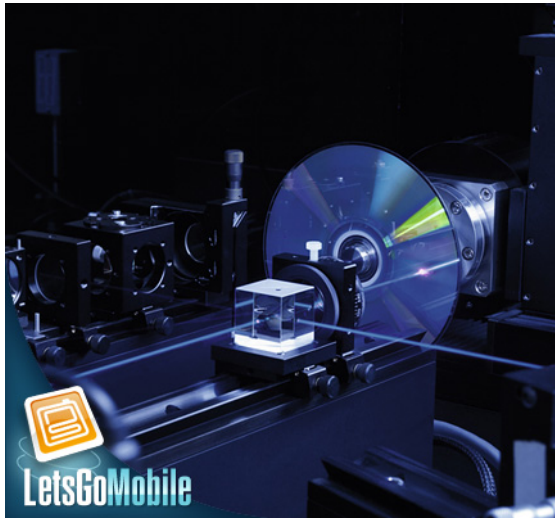
Posted by Ralf Jurrien



Optical data storage developments

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Small and round, it provides enjoyable, crackle-free, crystal-clear sound, and it set off an acoustic revolution 25 years ago: the first pop CD to be made from Bayer MaterialScience's (BMS) high-tech material Makrolon polycarbonate (PC) was ABBA's album "The Visitors" in 1982. The compact disc produced the songs of the Swedish cult band in a sound quality that was totally new at the time, so that this shiny object totally changed the international music industry. It also changed the way people listened to music - forever. What is more, it heralded the global conquest of optical data storage.



Compact disk evolution

With the release of "The Visitors," the era of the compact disc had officially begun, and over the next few years this technology gradually replaced analog recordings on records and magnetic tape. In 1996, it was followed by the DVD. Today the first HD-DVD and Blu-ray discs have reached the shelves, offering up to 80 times the capacity of a CD and producing razor-sharp images on today's widescreen TV monitors, with a quality that is totally unprecedented. Better and better materials and technologies are permitting the use of increasingly larger data volumes. The future belongs to holographic media, with the storage of several hundreds of gigabytes. As before, materials from Bayer MaterialScience are leading this technology.

Compact Audio disc technology development

For the last quarter of a century the primary substrate material for CDs has been polycarbonate, such as high-tech Makrolon polycarbonate from Bayer. Working together with Philips and PolyGram, Bayer developed compact disc technology based on a specially tailored type of polycarbonate which still serves as the material for many optical recording media, although it has undergone a number of modifications since the early days.

Makrolon polycarbonate Audio CDs

The Bayer researchers set to work on Makrolon polycarbonate and succeeded in modifying it for the special requirements of manufacturing processes in the music industry. The aim was to achieve the highest possible optical quality and transparency in the substrate, so that a laser head could read the digital code of a CD without any errors. Dr. Dieter Freitag was among the early pioneers. The former head of Central Materials Research at Bayer AG had already developed polycarbonates with an extraordinary level of flowability. This is vital for the production of CDs, because the plastic has to spread quickly and evenly within the mold. "What I didn't know, however, was that, with this product, we would be able to split a Beethoven symphony into four billion pits and then press them onto a disc with a diameter of 12 centimeters," said Freitag. With Makrolon polycarbonate, Bayer MaterialScience gave the industry a specially tailored material that would meet - and indeed still meets - the highest requirements with respect to storage capacity, data readability and stability.



Optical recording media development

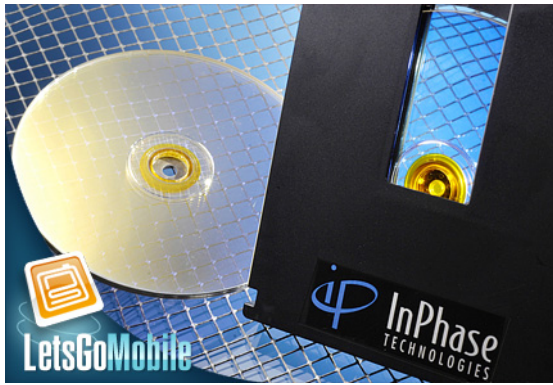
The outstanding sound quality and excellent durability of the new audio CD marked a paradigm shift in the technical recording of music and led to an amazing boom from the very first day of its market launch. The digitization of sound and music suddenly brought perfect musical enjoyment into our living rooms. Over 900,000 metric tons of polycarbonate are currently used for the production of optical recording media. Whereas in 1982 it took 27 seconds to produce a CD, production time has now been reduced to less than three seconds.

Optical data storage development

Data storage has been developing at a steady pace over the last 25 years. One collaborator with Bayer MaterialScience has been Sony. The first CD-ROM (ROM = read only memory) was launched in 1992, with a storage volume of more than 450 floppy discs. It was suddenly possible to store entire reference works and to call them up whenever required.

Digital versalite disc DVD

Only two years later computer users could simply "burn" and archive their documents to recordable or rewritable CDs (CD-Rs or CD-RWs). The next logical step was the DVD (digital versatile disc), an optical recording medium that can hold several times as much data as a CD (4.7 gigabytes): in 1996, 14 years after the launch of the compact disc, it took the world by storm. Like the CD, it was followed a few years later by a "burnable" version.



HD-DVDS & Blu-ray discs

Now even greater data densities can be achieved on discs through the use of blue lasers, which have shorter wavelengths than red or green ones and can, therefore, be focused more precisely. The new optical engineering technique is used in HD-DVDs and Blu-ray discs with storage capacities of 15 to 100 gigabytes, making these the only discs that can fully satisfy the digital data requirements of high-definition TV. The storage volume of a Blu-ray Disc today is nearly 80 times that of a Compact Disc (650 megabytes). This achievement was made possible by shortening the wavelength of the laser beam used to read and write the data, from infrared (CD), to red (DVD) and then to blue light (Blu-ray Disc, HD-DVD). As a result, data can be written and read on a considerably narrower area. Even the size of the pits - the indentations containing information - has decreased over the years. The smallest possible structure on a Blu-ray Disc is just one-fifth the size of a pit on a Compact Disc. In addition, the distance between individual data tracks has been reduced by some 80 percent.

Holographic data storage media

Researchers at BMS are already working with companies such as InPhase Technologies of Colorado on holographic storage media (manufacturing partner: Maxell) which are set to continue the revolution in digital data discs. The new disc type - called Tapestry - has a capacity of 300 gigabytes and is currently in its test phase. Unlike a conventional CD or DVD, data is no longer written and read bit by bit, but stored in the form of holograms, i.e., in entire data blocks all at once. This means that the read/write process can be accelerated many times over.

Makrolon Polycarbonate multi-purpose

Thanks to its versatility, Makrolon polycarbonate now has a world market share of 30 percent and is one of the best-selling products of the Bayer Group. Between the launch of the CD in 1982 and 2006, more than 90 billion optical data media were made from this material, including music, images, videos, games and software. The multi-purpose Makrolon polycarbonate not only serves as a material for recording media, but it is also used in the electronics, construction and automotive industries as well as in sports, leisure and medical markets. Numerous insights have been garnered from the use of Makrolon polycarbonate in CD manufacturing and were subsequently applied to other areas. When Philips replaced analog with digital technology, Bayer replaced vinyl with Makrolon polycarbonate and a vision became reality.

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