The Science & Technical Research Laboratories are researching ultrahigh-resolution plasma display panels (PDPs) with 0.3-mm square pixels. The goal is the construction of a display device for the Super Hi-Vision (SHV) system with 33 million pixels, i.e., 16 times the pixels of the current HDTV system. The pixels of the ultrahigh-resolution PDP are affected by microscopic phenomena that are insignificant for the conventional pixel size, but lead to various problems, such as larger power consumption, for screens with extremely small pixels. To solve these problems, we are devising performance guidelines that will be founded on research into the light emission phenomenon.

**Light emission principle of PDPs**

The light emission principle of a PDP is similar to that of a fluorescent light. The application of a voltage to discharge cell electrodes of the pixels produces an electrical discharge, leading to the emission of ultraviolet rays by the gas inside the cell (filler gas). When the emitted ultraviolet rays incident on the phosphors inside the discharge cell, the cell emit visible light (Figure). However, the small size of the PDP discharge cell and the first discharge control required for the video display make the phenomena occurring inside more complex than in a fluorescent light. Another difference is the filler gas used: mercury in fluorescent lights, xenon gas in PDPs.

**What is xenon gas?**

Xenon (Xe) is a member of the group of elements called noble gases. It has unique properties, as indicated by the etymology of the Greek word xenos (meaning “peculiar”), including the property of being somewhat resistant to colliding with electrons at a specific energy*. Other noble gases including helium (He) and neon (Ne) are also resistant to chemical reactions. Noble gases do not ordinarily corrode metal and they are used to inflate balloons and in neon signs. Among the noble gases, xenon has the highest luminous efficiency because of its ability to emit ultraviolet rays at a low energy. Hence, it has been widely used in PDP systems.

**Successful video display on ultrahigh-resolution PDP**

The smaller pixel size in an ultrahigh-resolution PDP makes it possible for the emission of ultraviolet rays by the xenon gas to be dissipated by various factors. We have found that a higher filler gas pressure alleviates this problem and leads to brighter emissions. A prototype system incorporating this technology in a small ultrahigh-resolution PDP was exhibited at the STRL Open House in 2005. The display was a step towards the realization of a PDP system for SHV (see picture).

The current luminous efficiency of the PDP is only about 1%, whereas a xenon lamp using the same xenon gas is said to have a luminous efficiency of around 40%. Hence, we will continue to draw out the potential of xenon gas, with the goal of fabricating a home use SHV plasma display system with low power consumption.

* A phenomenon called the Ramsauer effect, which is explained by quantum mechanics.

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![Figure: PDP’s discharge cell structure and light emission principle](image1)

**Picture: Video reproduced on a 6.5-inch diagonal ultrahigh-resolution PDP with 0.3-mm pixel pitch**
large volumes of NHK’s content are stored on magnetic tapes. To ensure effective use of these contents in the future, we are working on a way to reproduce the magnetic tape data at high-speed by using laser beams. "Magnetic transfer film is the key device in this research, and magnetic garnet is suited for the film.

What Is Magnetic Garnet?

The Faraday effect is a magnet-optic effect in which the plane of polarization rotates as linearly polarized laser beam propagates through a material with magnetization in a uniform direction. Using Magnetic garnet, a large Faraday effect can be derived. This material for example is used in a device that allows light to pass in only one direction (optical isolator). We are trying to use magnetic garnet for high-speed reproduction from magnetic tape.

Magnetic Transfer Film

By the Faraday effect, the direction of the polarization plane rotation changes with the magnetization direction. As shown in Figure 1, when a magnetic tape is run in close proximity to a magnetic transfer film the direction in which the magnetic garnet film is magnetized follows the direction of the magnetic flux from the magnetic tape. The plane of polarization of the reflected laser beam changes depending on the direction of the magnetic field. This enables data recorded on the magnetic tape to be detected by using laser beam.

Magnetic garnet is easily magnetized by an external magnetic field; it simply requires contact with the magnetic tape to transfer the data pattern recorded on the tape. Figure 2 is a picture of transferred data pattern from magnetic tape to the magnetic garnet film, as observed with a polarization microscope. It clearly shows that the data recorded on the tape has been transferred to the film.

Working toward High-speed Magnetic Tape Reproduction

The above method will enable the simultaneous parallel data readout of approximately 500 data tracks in the tape width direction, and it allows much faster reproduction compared with conventional data readout methods. To realize high-speed data reproduction, we will develop higher-performance magnetic garnet film. It will also be necessary to develop the procedure to run magnetic tape closely contact with the magnetic transfer film.

Figure 1 Magnetic tape reproduction using magnetic transfer film and laser beam

Figure 2 Magnetic transfer film observed with a polarization microscope (transferred data pattern from magnetic tape)