Researcher's 3-D Digital Storage System could hold a library on 1 disc

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Imagine taking the entire collection of historical documents at the Smithsonian National Air and Space Museum and storing it on a single DVD. University of Central Florida Chemistry Professor Kevin D. Belfield and his team have cracked a puzzle that stumped scientists for more than a dozen years. They have developed a new technology that will allow users to record and store massive amounts of data -- the museum's entire collection or as many as 500 movies, for example -- onto a single disc or, perhaps, a small cube.

Belfield's Two-Photon 3-D Optical Data Storage system makes this possible.

"For a while, the community has been able to record data in photochromic materials in several layers," Belfield said. "The problem was that no one could figure out how to read out the data without destroying it. But we cracked it."

Think of it this way. Television viewers can tape a show on a VHS tape. They can use the tape several times. But each time the same segment of the tape is used, the quality diminishes as the tape wears out. Eventually, the data is lost. The same is true of recordable DVDs.

Belfield's team figured out a way to use lasers to compact large amounts of information onto a DVD while maintaining excellent quality. The information is stored permanently without the possibility of damage.

The process involves shooting two different wavelengths of light onto the recording surface. The use of two lasers creates a very specific image that is sharper than what current techniques can render. Depending on the color (wavelength) of the light, information is written onto a disk. The information is highly compacted, so the disk isn't much thicker. It's like a typical DVD.

The challenge scientists faced for years was that light is also used to read the information. The light couldn't distinguish between reading and writing, so it would destroy the recorded information. Belfield's team developed a way to use light tuned to specific colors or wavelengths to allow information that a user wants to keep to stay intact.

The UCF team's work was published in Advanced Materials (2006, vol. 18, pp. 2910-2914, http://dx.doi.org/10.1002/adma.200600826) and recently highlighted in Nature Photonics (www.nature.com/nphoton/reshigh/2006/1106/full/nphoton.2006.47.html). A patent is pending.

Once the technology is fine-tuned, it could be used to store historical documents or create complicated databases that could give decision-makers quick access to critical information, Belfield said.

Blu-Ray Disc Association and industrial leaders in computer and other media recently commercially introduced Blu-Ray Disc technology that allows for storage of 25 gigabytes (GB) on a single layer of a disc and 50 GB on two layers. It has been referred to as the next generation of optical disc format, and it offers high-definition quality.

Belfield's technique allows for storing on multiple layers with the capacity of at least 1,000 GB and high-definition quality.

The UCF team has received a $270,000, three-year grant from the National Science Foundation to continue its work. The team will focus on making the technique even more efficient, partly by reducing the required laser power.

The team's work with lasers and lights has other practical applications. Belfield and his colleagues in the Department of Chemistry are exploring the use of light to detect and treat certain types of cancer.

Belfield's research team is creating chemical agents that, after being injected into patients, will travel within the bloodstream to find and bind with cancer cells. Using light, doctors would then be able to see if and where a patient has cancer cells. Another agent could be injected that would then destroy the cancer cells when activated by light, without damaging other healthy cells.

Source: University of Central Florida