Photosensitive Glass Changes Light Properties to Create Holograms

University of Central Florida

For Leon Glebov, Ph.D., and Larissa Glebova holographic imaging boils down to one of the most common yet powerful materials on the earth — glass. The Glebovs, scientists at the University of Central Florida College of Optics & Photonics, developed a new method of writing microscopic holograms or pathways into glass that can direct light to perform specific functions.

The invention came after years of research at the renowned Vavilov State Optical Institute of St. Petersburg, Russia, and refined at UCF. The hologram provides a pathway and direction for the light beams that pass through it and, in the case of the Globovs' work, can actually change some of the properties of the light. Holograms also have applications in a variety of commercial uses including cutting, welding and drilling processes in the automotive, aerospace and ship industries.

Most consumers recognize holograms as the reflective logos on credit cards, but few realize the amount of data contained in those images. Holograms are full of information about the size, shape and brightness of the object being recorded. Laser light records the data, and incoming light unlocks the image for the viewer. Holograms make it possible to control laser beams and store large amounts of data and have archival potential superior to compact discs and photographic film.

Glebov applied to UCF's Technology Incubator and received office space for his new company, originally called Light Processing Technologies Inc. and recently renamed OptiGrate Inc. He entered into a partnership with UCF for an exclusive license of the core technology. Since its founding in 1999, the UCF Technology Incubator — a collaboration of UCF, Orange County, the City of Orlando, the Florida High Tech Corridor Council and the Metro Orlando Economic Development Commission — has helped more than 870 emerging technology companies create more than $1.5 billion in revenue and approximately 600 jobs.

Read about the UCF Technology Incubator at www.incubator.ucf.edu, and OptiGrate Inc. at www.optigrate.com.

Crystal Layering Breakthrough Makes Blue LEDs Possible

Boston University/Boston Medical Center

Light emitting diodes, or LEDs, appeared about 40 years ago when researchers first figured out how to squeeze light out of compound semiconductor crystals. When electricity flows through these crystals, they emit photons of light at a certain wavelength, depending on the composition of the crystal.

Early LEDs were made with a compound called gallium arsenide, and they produced only weak red and green glows suitable for clock and calculator displays. But about a decade ago, engineers invented a crystal made of aluminum gallium indium phosphide that produced a brighter red light.

Producing light with shorter wavelengths requires compound semiconductors with higher band gaps such as gallium nitride, which yields blue light. The problem with producing LEDs from gallium nitride is that the artificial substrates on which photo-emitting layers are deposited have a different crystal lattice spacing than gallium nitride, making it impossible to grow single crystal layers of gallium nitride on the sapphire.

Ted Moustakas at Boston University's Photonics Center solved this problem by developing the buffer-layer process, a two-step method for depositing a bridging layer of gallium and nitrogen atoms onto silicon, sapphire and other substrates. In August 1991, Moustakas published a paper detailing the buffer-layer process; it remains the only known way to make blue LEDs.

As Moustakas was reporting his early successes with gallium nitride, Shuji Nakamura, an engineer at Nichia Chemical Industries Ltd., then a small family-owned chemical company in Japan, was racing to perfect the technique as well. Several months after Moustakas' publication Nakamura published similar results in a different journal, then built the first working blue LED.

In 2001, Boston University licensed the buffer-layer patent to Durham, N.C.-based Cree Inc., a North Carolina State University startup company. Cree, Boston University and Nichia Chemical Industries entered into a patent cross-license agreement in 2002. Today, both companies sell LEDs to customers who use them in full-color displays in cellular phones, handheld personal organizers, arena display boards and traffic lights.