Sol-Gel Glass Holographic Light-Shaping Diffusers

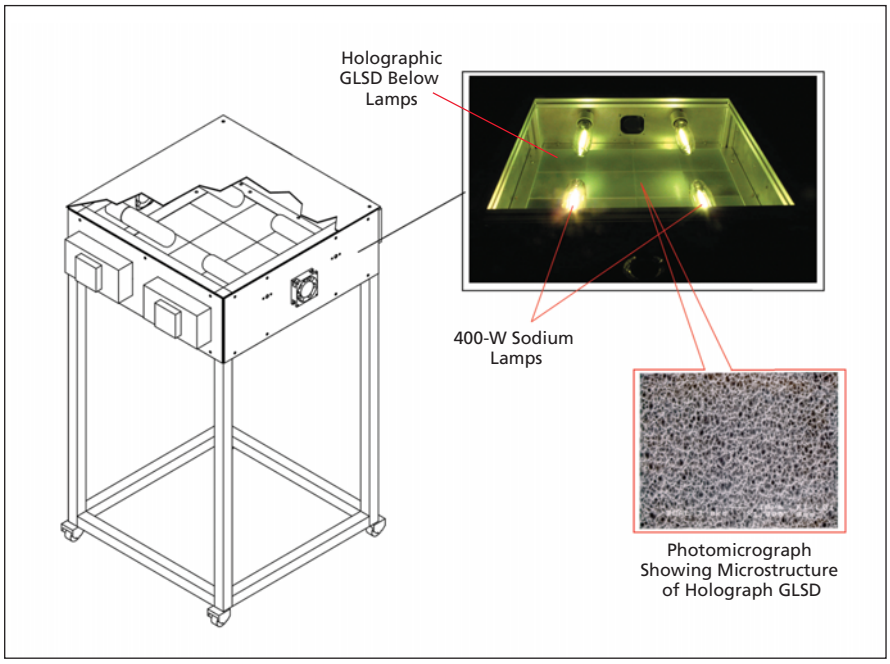
Defined areas can be illuminated diffusely with high efficiency.

John F. Kennedy Space Center, Florida

Holographic glass light-shaping diffusers (GLSDs) are optical components for use in special-purpose illumination systems (see figure). When properly positioned with respect to lamps and areas to be illuminated, holographic GLSDs efficiently channel light from the lamps onto specified areas with specified distributions of illumination — for example, uniform or nearly uniform irradiance can be concentrated with intensity confined to a peak a few degrees wide about normal incidence, over a circular or elliptical area.

Holographic light diffusers were developed during the 1990s. The development of the present holographic GLSDs extends the prior development to incorporate sol-gel optical glass. To fabricate a holographic GLSD, one records a hologram on a sol-gel silica film formulated specially for this purpose. The hologram is a quasi-random, micro-sculpted pattern of smoothly varying changes in the index of refraction of the glass. The structures in this pattern act as an array of numerous miniature lenses that refract light passing through the GLSD, such that the transmitted light beam exhibits a precisely tailored energy distribution.

In comparison with other light diffusers, holographic GLSDs function with remarkably high efficiency: they typically transmit 90 percent or more of the incident lamp light onto the designated areas. In addition, they can withstand temperatures in excess of 1,000 °C. These characteristics make holographic GLSDs attractive for use in diverse lighting applications that involve high temperatures and/or requirements for high transmission efficiency for ultraviolet, visible, and near-infrared light. Examples include projectors, automobile headlights, aircraft landing lights, high-power laser illuminators, and industrial and scientific illuminators.



The **Holographic GLSD** in this lighting system concentrates and diffuses light from four lamps onto the framed area below. This lighting system is designed specifically for illumination experiments on growing plants under controlled conditions.

This work was done by Kevin Yu, Kang Lee, Gajendra Savant, and Khin Swe (Lillian) Yin of Physical Optics Corp. for **Kennedy Space Center**.

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

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Refer to KSC-12436, volume and number of this NASA Tech Briefs *issue, and the page number.*

Automated Counting of Particles To Quantify Cleanliness

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A machine vision system, similar to systems used in microbiological laboratories to count cultured microbes, has been proposed for quantifying the cleanliness of nominally precisely cleaned hardware by counting residual contaminant particles. The system would include a microscope equipped with an electronic camera and circuitry to digitize the camera output, a personal computer programmed with machine-vision and interface software, and digital storage media. A filter pad, through which had been aspirated solvent from rinsing the hardware in question, would be placed on the microscope stage. A high-resolution image of the filter pad would be recorded. The computer would analyze the image and present a histogram of sizes of particles on the filter. On the basis of the histogram and a measure of the desired level of cleanliness, the hardware would be accepted or re-