

Diffraction Laser Solutions

NEWSLETTER - Volume 6 , Winter 2005 www.dlasersolutions.com , www.lambda.cc

If you are doing work in the field of [laser beam shaping](#) or developing application that use [laser beam shaping](#) you should consider submitting an abstract for the annual SPIE conference in San Diego, August 13-17th, 2006. The deadline for abstract submission is January 30th, 2006. Here is a link for more information.

<http://spie.org/conferences/calls/06/op/conferences/index.cfm?fuseaction=OEI413>

Kurt Kanzler, president of Diffraction Laser Solutions Inc. accepted a position as Manger of Engineering Projects at Lambda Research Optics starting in June 2005. Lambda Research Optics licensed DLS's beam shaping technology and launched a new productline of beam shapers called LaseRemap. **DLS was issued US patent 6975458 on December 13th, 2005 for a "Method and Apparatus for transformation of a Gaussian laser beam to a far field diffraction pattern"**. This patent describes the technology used in Lambda's new product called LaseRemap.

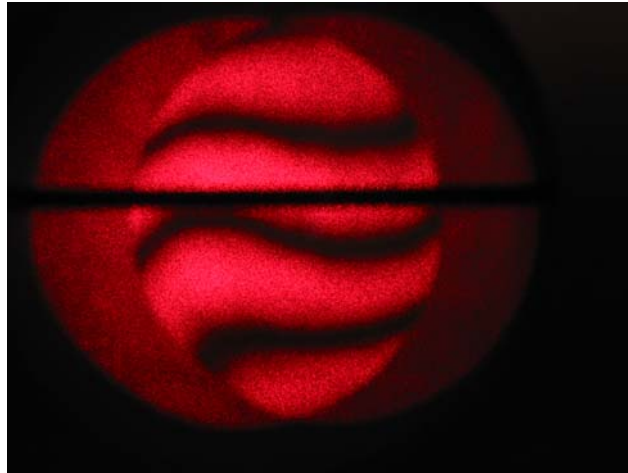
Laser Beam Shaping:

PHASE AND INTENSITY?

It's clear from a design point of view that the only way to make a flat-top intensity and flat-top phase is to use two optical elements. However, a single element can do the job over a limited diameter with impressive results for comparable energy utilization. Over a large portion ($> 70\%$) of the diameter the wavefront can be flat in intensity to $< 5\%$ PTV and < 0.2 waves of phase flatness PTV. Most interference based techniques can be performed inside this range using the shaped laser beam. These conditions were met with a very high quality gaussian source and a near perfect M^2 . For many laser users performing holography(and other applications) a serious loss of energy is designed into the system by overfilling the exposure area to use the "sweetspot" of the gaussian beam. For a gaussian beam a very small central portion is flat in intensity and phase. If we use a simple rule of thumb, $\pm 5\%$ PTV is 10% energy utilization, and $\pm 15\%$ PTV is 30%. With this guideline we can now estimate requirements for uniformity of intensity and phase for a given application and that will tell us how much energy we could use in the gaussian beam.

It's now easy to see why the central area from a > 80 % efficiency diffractive optic can still be many times more efficient than overfilling an exposure area with a gaussian beam to try and get a flat top.

Recent test data taken at DLS using shearplate interferometry shows very high contrast flat fringes over the central portion of the shaped uniform intensity beam. Below is a fringe pattern with the shearplate technique on a collimated shaped round tophat beam.



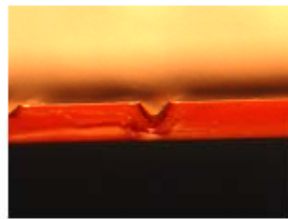
Application:

1. Laser Annealing – The current state-of-the-art for thin film annealing of flat panel display screens uses an Excimer laser. This highly incoherent Excimer source uses an integration beam shaper (fly's eye lens) to create a uniform profile at a mask plane, then the mask is re-imaged to the final working plane. This re-imaging is costly in terms of \$ and energy loss. Mask re-imaging can block out a large (>50%) portion of the laser energy. Since Excimers are typically higher power, this loss is affordable presently, however, DPSS lasers are moving in this direction. New diffractive beam shaping systems are being built with TEM₀₀ fundamental gaussian lasers with positive results. The size and running cost of the typical DPSS laser is clearly an advantage over the Excimer. As the power increases for these DPSS lasers, this technology coupled with diffractive beam shaping will move forward as an enabling combination to make very high aspect ratio lines possible. Diffractive beam shaping can shape square edges very nicely and this lends itself to a geometric fit for the typical panel substrate.
2. Holography - In demanding applications like holography, exposure time is critical and single element diffractive optics solutions are reducing these exposure times by 2-3 X. Large diameter uniform (in

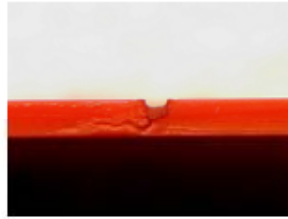
intensity and phase) shaped beams are being created and used in large area lithographic applications where sub-micron feature sizes are produced.

3. MicroMachining – In precision manufacturing small spot size tophats can afford a real advantage in thruput and quality. The milling of micro channels with a sharp,clear edge is difficult with a gaussian beam. These channels tend to round producing a V shape. Look at the difference between gaussian and tophat in this photo.

Gaussian vs. Round Tophat for CO2 laser at 500 um spotsize in Vinyl



gaussian beam with serious edge taper

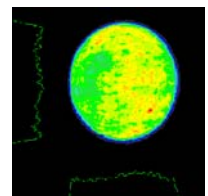


uniform round beam with minimal taper and a flat bottom

List of current applications: micro-via drilling, holography, micro-machining, bio-photonics, laser annealing, marking, welding, heat treating.

For more information on laser beam shaping, or diffractive optics visit our Website at www.lambda.cc or call our Sales at 714-327-0600

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